A QUARTERLY FORECASTING MODEL FOR THE INTERNATIONAL WHEAT AND FEED GRAINS SECTOR

ECONOMIC WORKING PAPERS

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✓Working Paper No. 13 - A Quarterly Forecasting Model for the International Wheat and Feed Grains Sector
Harry de Gorter
Ralph Lattimore

A Quarterly Forecasting Model for the International Wheat and Feed Grains Sector

Harry de Gorter and Ralph Lattimore

January 1981

Foreword

This is one of a series of working papers providing extensive background material and initial results of Agriculture Canada's Food and Agriculture Regional Model (FARM), a large scale, quarterly forecasting model of Canadian markets for agricultural commodities, food and inputs. The project is a cooperative effort of a number of staff in Agriculture Canada, five Canadian Universities and contract consultants.

These working papers report on preliminary results obtained from the project to date. The results include, in most cases, tests of earlier hypotheses, thus providing a chronology of the development of the model. Further revisions of the model are continuing and a technical report outlining the complete model is forthcoming.

These working papers are being released on a limited basis at this time not only to provide an indication of work ongoing but more importantly to obtain reviews and critiques of professionals and potential users. Results presented in this report are preliminary and should not be cited without the permission of the author(s) or the Project Director. Comments should be forwarded to the author(s) or to H.B. Huff, Project Director of FARM, Policy, Planning and Economics Branch, Agriculture Canada, Ottawa K1A 0C5.

A number of people have been instrumental in preparing the results presented in this report. The author(s) however accept responsibility for the final content of the paper.

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A Quarterly Forecasting Model for the International Wheat and Feed Grains Sector

Harry de Gorter and Ralph Lattimore

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Harry De Gorter and Ralph Lattimore

SECTION 1

Introduction

1.0 INTRODUCTION

This study reports on the preliminary results obtained in the construction of a quarterly international forecasting model of the wheat and feed grains sectors. The problem of generating timely forecasts has become more apparent with the unprecedented rise of agricultural and food prices in the 1970's. The continued volatility in food prices has directed attention to commodity analysis in particular and to economic forecasting in general. The inflationary spiral precipitated partly by food prices in this decade has resulted in both public and private economic agents requiring increasingly integrated and complex models of the agricultural sector for forecasting and decision purposes. Over the years, a number of complex, multi-dimensional, agricultural commodity models have been developed for exploring past price movements and forecasting the future. This study develops a model of the international grain market.

The uncertain economic climate of this decade was influenced by the turbulent developments in the international wheat and feed grain markets. The reduction in stocks, changed governmental programs and uncertain conditions in international markets are among the factors responsible for the intensified interest in forecasts of key economic variables present in the grain economy. The urgent and demanding interest in wheat and grain market forecasts is magnified by its importance indirectly in the developments of meat, eggs and dairy product prices, and directly

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in the determination of the CPI for food and its favourable contribution to the balance of payments. Hence, accurate forecasts enables more enlightened policy formulation and correspondingly better resource allocation at all market levels of the agricultural industry.

An understanding of the supply, demand and short and long term price relationships in the international wheat and feed grain industries are critical for changes in the sector to be anticipated so that optimal decisions can be orchestrated by those involved in the production, marketing and policy processes of agriculture. A forecasting model presents a necessary component of providing decision makers with detailed information of the structural parameters and the future developments in the wheat and feed grains sectors. The purpose of this study is to capture in a quantitative framework the basic economic relationships affecting the determination of prices in the international grain economy so as to derive a better understanding of the grain markets and to forecast key economic variables.

1.1 OBJECTIVE

The primary objective of this study is to identify the structural parameters which affect the supply, demand and price determination processes of the international wheat and feed grain markets. In order to meet this objective, an econometric model is developed capable of generating forecasts on a quarterly basis. The model presented is very simplistic in structure with a high level of aggregation in both regions and commodities.

However, the model developed in this paper is constructed so as to be compatible with the other sectoral models of the comprehensive forecasting model being constructed by Agriculture Canada[1/]. The level of aggregation is consistent with the other models in terms of regions and time periods (quarterly). In particular, the model is linked to the livestock, poultry and dairy models through feed demand equations, which are affected by livestock, poultry and milk production and prices. Furthermore, feed demand is determined in part by soybean meal prices. Likewise, variables endogenous in the following model are linked to the livestock and other models. Specifically, feed grain prices at the farm level affect livestock, poultry and milk supply (slaughter and inventory changes) as well as various cost of production formulae computed in the poultry and dairy sectors. Furthermore, wholesale grain prices are linked to the consumer price index directly and to retail demand block for food and industrial demand for grain products. In addition, soybean meal prices are a factor in determining export demand for both feed grains and wheat in Canada and the U.S. Finally, the farm income block are dependent on the endogenous prices, exports, and marketings in the following model.

1.2 RELATIONSHIP TO PREVIOUS RESEARCH

There have been several econometric models developed in the past for wheat and feed grains. For the U.S., several annual models have been constructed, mostly for the purposes of policy analysis. The models specific to feed grains include King (1958), Meinken (1953),

1/ See other working papers in this series and the complete report by Agriculture Canada on the FARM project.

Meilke (1971, 1972), Roy and Ireland (1974), Womack (1976), Hein (1977) and the U.S.D.A. (1977). Annual wheat models developed for the U.S. specifically include Meinken (1955), Mo (1968), Barr (1973), Gomme (1972) and by the U.S.D.A. Each of the aforementioned models are annual, aggregate, national, and do not explore the interactions between wheat and feed grains. Several annual U.S. models consider feed grains and livestock sectors together including Cromarty (1959), Egbert and Reutlinger (1965), Foote (1953) and Hildreth and Jarret (1955).

Annual international grain models have been developed by Bjarnason (1968), Schmitz et al (1973), Coffin (1973), Kost (1975), Zwart (1977), and Rojko (1977).

The model developed in this study is quarterly, solves the wheat-feed grains sectors simultaneously and is international in scope including both the U.S. and Canada. The only complete quarterly forecasting model published for Canada and the U.S. which determines endogenously the world price of feed grains is reported in de Gorter (1977) and Meilke and de Gorter (1978).

Three U.S. specific agricultural models constructed by private firms such as Wharton, Chase and DRI contain quarterly wheat and feed grain models.

Several annual Canadian models for feed grains, Reimer and Kulshreshtha (1974) and LaForge (1974) have also been developed but assume the world prices as exogenous.

The model presented in this paper follows de Gorter (1977) and adds a quarterly wheat model, extends the Canadian sector since data was was developed in the course of this study, and disaggregates the U.S.S.R. from the rest of the world export demand components.

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In addition, the following model is constructed so as to link with the other livestock, poultry, dairy and oilseed components developed in the Agriculture Forecasting Sector Model at Agriculture Canada.

1.3 OUTLINE OF PAPER

In Section 2, a brief description of the characteristics of the international wheat and feed grain markets is presented, with emphasis on Canada. In addition, a short review is given of the economic and policy developments in the grain and livestock industries so as to provide an analytical background for the specification of the model. Some theoretical background for analyzing the grains market in a quantitative framework is presented in Section 3, followed by a presentation of the model structure in Section 4. Section 5 contains the detailed specification of the econometric model and Section 6 contains the results of the historical validation, a short prediction interval test and an evaluation of the models performance. Finally, Section 7 deals with the conclusions, model limitations, suggestions for improvements and considerations for further research.

2.0 ELEMENTS OF THE WHEAT-FEED GRAIN INDUSTRY

2.1 INTRODUCTION

This section provides a brief overview of the wheat and feed grain markets in Canada, the U.S. and the rest of the world (ROW). This overview will be helpful in understanding the econometric model developed in subsequent sections. From this, a rationalization of the individual

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components, level of aggregation and regional disaggregation becomes more apparent. The historical review deals with trends in crop and livestock production, utilization, trade and government policies that affected and were related to the grains industry over the time period studied.

2.2 GRAIN PRODUCTION

Wheat and feed grain production levels are presented for Canada, the U.S., the U.S.S.R. and the rest of the world from 1967 to present in Table 2.1. It is evident that feed grains production has grown more rapidly than for wheat. The largest source of variation in production is in yields which are largely affected by disease and variation in climate. A significant fluctuation in world grain production can have a large impact on the variability of North American exports, contributing to world price instability. Therefore, the trends and variability in world grain production have a significant impact directly on Canadian grain exports and prices, and indirectly on livestock output and farm cash receipts.

2.3 DOMESTIC GRAIN UTILIZATION

Wheat and feed grains are utilized in many ways but in the aggregate can be divided as food and industrial use, feed to livestock, and seed; the latter of which constitutes a small proportion of the total disappearance. Data for the respective uses for each region are displayed in Table 2.2.

Grain utilized for food and industrial purposes is relatively stable and has trended upward over time. Moreover, there is little substitution in demand between wheat and feed grains in this category.

On the other hand, feed demand has increased over time, a major portion of this growth being accounted for by the steady growth in overall livestock production over the past two decades. However, the high grain prices in 1974-75 discouraged feed use somewhat and the current low levels of beef and hog production has limited feed disappearance. However, feed use is the largest consumption outlet for feed grains in Canada and the U.S., rendering it very important in the modelling effort in order to capture the movements in feed grain prices. Wheat used for feed in North America is far smaller relative to feed grains although wheat used for feed in Canada approached 20 percent of production in the early 1970's. There is a high degree of substitution between wheat and feed grains in feed demand.

The use of feed grains exhibits high seasonality during the course of a year. In the fourth calendar quarter, approximately one-third of the total yearly feed usage takes place. This is due mainly to low seasonal prices for feed grains, and the abundance of supplies during the harvest period and the availability of pasture. Feed usage progresses downward in the winter and spring seasons and is lowest in the summer. The small summer consumption is due primarily to three factors: (1) beef and dairy cattle are on pasture; (2) seasonally low hog production, and (3) low seasonal prices for wheat which is substituted for feed grains as feed.

Livestock accounts for a major portion of growth in feed demand. Feed conversions have changed over time with the improvement of feeding practices and animal breeds. This phenomena is most pronounced in poultry production where feed conversion ratios have doubled in the past decade, having significant repercussions on corn demand since corn is the

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major input in poultry production. Feeding rates have also changed as farmers found it profitable to change feeding levels in response to changes in input and output price. The livestock/grain price ratio has declined sharply since the commodity boom of 1972 and rising grain in the face of increasing grain supplies, having several implications for the feed grain and livestock industries. First, feeding rates per animal dropped and second, therewas a shift from grain-fed to grass-fed beef. The change in the composition of beef production in the United States since 1970 has been from 97 percent (1973) fed to 75 percent fed (1975)[1/]. These developments have lowered the demand for feed in both the short-run and the long-run, as cattle breeding herds have been liquidated in response to the relatively low beef prices. Developments in the past two years has reversed the aforementioned scenario whereby livestock prices are high whilst the feeding rates and the proportion of cattle on feed has increased markedly.

2.4 GRAIN INVENTORIES

The levels of grain inventories in Canada, the U.S., the ROW and U.S.S.R. are included in Table 2.3. Through the early 1970's, Canada and the U.S. accumulated large levels of inventories under government program in the U.S. and CWB marketing quota policies in Canada. During the period 1971-73, grain stocks were depleted with the surge in exports resulting from increasing ROW incomes, changes in U.S.S.R. procurement policies and production shortfalls over the world, all precipitating the commodity boom. However, inventory levels for grain are approaching levels reached prior to the aforementioned commodity boom.

1/ U.S.D.A. Livestock and Meat Situation (various issues).

Canada has not had a general policy of public financial stockholding and production control. The Canadian Wheat Board (CWB) controls farm stocks of grain indirectly and commercial stocks directly for the majority of grain (Western Canada) by imposition of quotas on farmer marketings of grain to the commercial elevator system. Otherwise, market forces prevail for farmers in allocating resources for production, feed demand and farm stocks. In Eastern Canada, the grain market is affected by the CWB pricing of Western Canada grains in Eastern Canada, recent stabilization programs, feed freight assistance programs, tariffs and CWB control over barley, oats and feed wheat shipments. In the U.S., the Commodity Credit Corporation (CCC) has influenced stocks directly with programs allowing government owned and controlled stocks to accumulate under minimum price supports (loan rates) and indirectly through voluntary land diversion programs and concessional sales.

2.5 INTERNATIONAL TRADE

Levels and trends in Canadian and U.S. trade in grains are displayed in Table 2.4. There are at least three relevant observations to be made. First, Canada and the U.S. account for a major proportion of world trade (exports) in both wheat and feed grains. Secondly, world trade in feed grains is higher than that for wheat and the former also is increasing over time at a faster rate. Thirdly, the increase in grain exports mostly has been to developed countries, particularly feed grains, for both feed and food uses. These increased exports are due primarily to the devaluation of the U.S. and Canadian dollar, increasing world incomes and meat consumption, shortfalls in ROW grain production and the emergence of the U.S.S.R. and China as major purchasers.

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In addition, a substantial amount of grain, particularly wheat, was exported under various aid programs in both Canada and the U.S. For some year, U.S. commercial exports of wheat was less than aid shipments. These aid shipments alleviated the downward pressure on domestic prices but were also substituting for a portion of commercial exports which would have otherwise occurred.

In summary, grain markets in Canada and the U.S., are heavily dependent on developments in world markets and consequently the factors which affect the demand for grain exports warrant close examination.

2.6 CANADIAN AND U.S. GRAIN PRICES

World wheat and feed grain prices have shown a large variance in the time period under investigation. A key element in this study is to explain and derive endogenously a representative world price of wheat (U.S. gulf ports) and feed grains (Chicago corn) through the interaction of supply and demand for each commodity at the international level. From these world prices, regional farm, wholesale, fixed export and import prices for both Canada and the U.S. are derived through the explicit specification of price linkage equations. This section discusses the policy developments and institution involved in Canadian agriculture which affect the relationships between these various aforementioned prices and the world prices.[2/] From this, a structural form of these price linkage equations can be specified.

2/ The actual Canadian export prices of wheat and feed grains are not published. The price series used in this study for Canadian exports are the unit F.O.B. prices published by Statistics Canada. In particular, the value of exports reported are divided by sales to obtain unit prices.

Commercial Grains Policy and Prices in Canada

Equitable and efficient pricing mechanisms have always been a concern to participants in the Canadian grain/livestock industry. In Western Canada, prior to the feedgrain policy of 1974, the flows and prices of feedgrains occurred in three markets and were under the sole authority of the CWB. The accumulation of feedgrain surpluses in the late 1960's caused the CWB to adopt a multi-pricing system so that they could maximize returns by price discrimination in three distinct markets. The three markets were (1) the export market, represented by the Canadian export price for wheat and barley, (2) the Prairie feedgrain market, which was not under the direct control of the CWB, since quantities and prices were allowed to move freely within each province, but was indirectly controlled by the CWB's power to restrict interprovincial grain movements and its control over access to the export market through delivery quotas; and (3) the Eastern Canadian market where prices were often maintained above the prices of the CWB's export sale prices and the non-board grain farm prices in the Prairies. For much of the time period prior to the new feedgrain policy in 1973, the feedgrain market in Western Canada was characterized by chronic oversupply, strict marketing quotas, distress prices and large stocks.

Since 1973, there has been a remarkable change in both market environment and government policy with regard to the Canadian feedgrain market. The turbulent change in world grain markets discussed earlier, coupled with the presumed inefficiencies resulting from price discrimination generated by the old policy, gave rise to a new feedgrain policy.

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The major revisions that made up the present policy include: (1) the removal of all restrictions on the movement of feedgrains within Canada, including the pricing and control of feedgrain shipments from Western Canada to Eastern Canada; (2) an agreement that the CWB would stand ready to supply feedgrains at a formula price, based on the price of United States corn in Montreal, (and more recently, the price of soybean meal) thereby setting a ceiling on Eastern Canadian feedgrain prices; (3) to avoid congestion, the CWB maintains the power to set delivery quotas for Prairie feedgrains, and remains the sole exporter of Canadian grains; (4) establish a storage program for up to 160 million bushels of grain at an annual cost of 40 million dollars; (5) provide a minimum price guarantee to prairie grain producers, for sales to the non-board domestic feedgrain market, at least equal to initial prices for CWB grain; and (6) establish a system for increased cash advances.

Clearly, the CWB maintains its direct control of the volume of imports/exports of wheat and feedgrains and can set the level of Canada's export price.

The changes in domestic feedgrain pricing ended the large discrepancy between off-board farm prices in the Prairies and the selling price charged by the CWB in Eastern Canada wholesale markets. Since the CWB has partially withdrawn from the domestic feedgrain market, private traders have tended to equalize farm and wholesale prices across Canada except for freight and similar expenses. The relative free market wholesale prices in Eastern Canada are below the prices which would have

existed under the old policy, and hence below the United States corn price in Montreal. The export prices of oats, barley and wheat are now higher than the domestic wholesale prices which was not the case before.

In summary, these are three distinct market prices for wheat and feedgrains relevant in Canada.

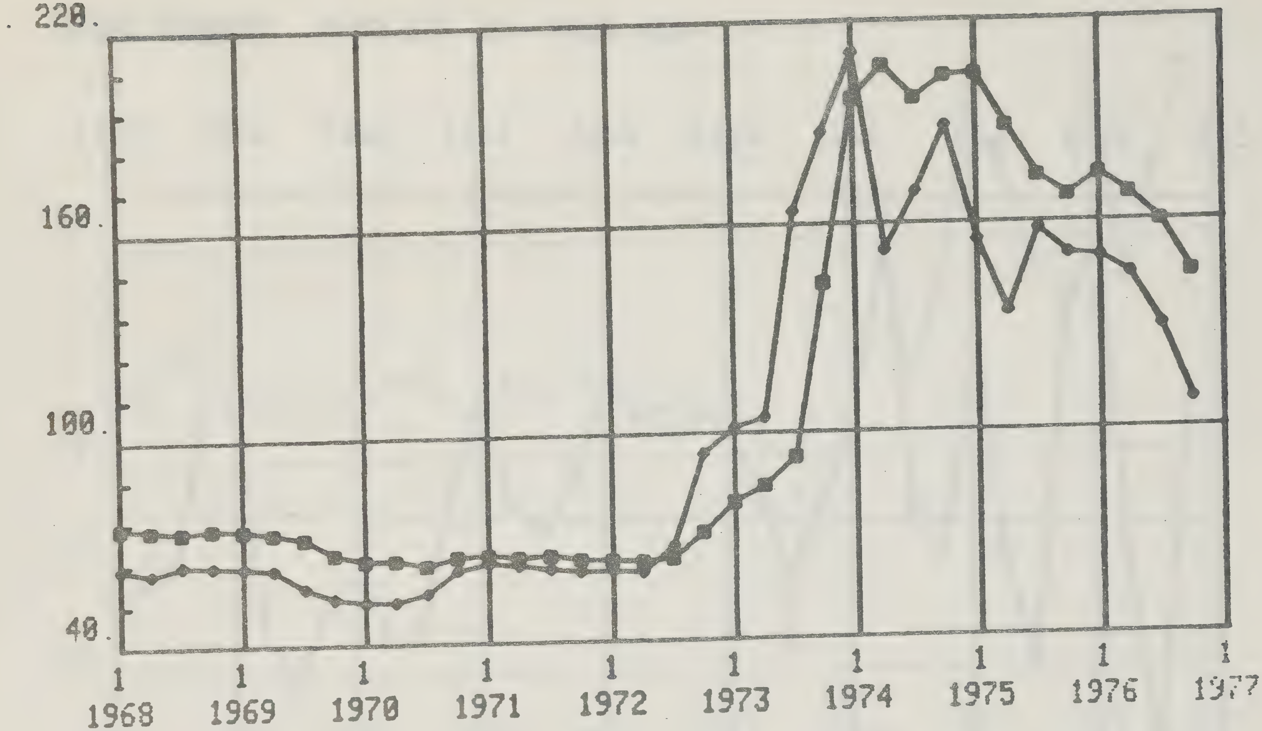
(a) The export prices for wheat barley and oats, the levels of which are set in relation to prevailing world prices by the CWB. The approach taken here is to solve for a world price with the model through the inter-actions of international supply and demand functions simultaneously for feed grains and wheat. The representative world prices used are U.S. gulf ports wheat price and Chicago corn price. From these prices, a price linkage equation is developed whereby the CWB export price is set in relation to this world price, (the latter of which is affected by Canadian exports, supply and demand) modified by economic variables hypothesized to affect the CWB's pricing behaviour. Figure 2.1 shows the relationship between the Canadian export price of wheat and the representative world price. The factors hypothesized to explain this relationship is discussed later but the nature of the data series may explain part of the discrepancy in that a reporting lag exists.

(b) The wholesale prices for barley, oats, feed wheat and corn in Montreal. These prices are set in relation to Chicago corn prices and were directly controlled by the CWB prior to 1974 and are indirectly controlled by the CWB since 1974. Figure 2.2 shows the Montreal barley - Chicago corn price differential and reveals erratic price movements between the two grains. Explanation for this is presented later.

(c) Off-board farm prices for barley, oats and wheat in the Prairies and Chatham corn prices in Ontario. As shown in Figure 2.3, these prices did not bear any direct relationship world feed grain prices, particularly after 1974 when the CWB relinquished control of inter-provincial movements of feed grains in Canada and prior to 1974, forced the adjustment on farmers when weak export markets prevailed and excess supplies developed in Canada.

FIGURE 2.1

Canadian and U.S. Wheat Price Movements



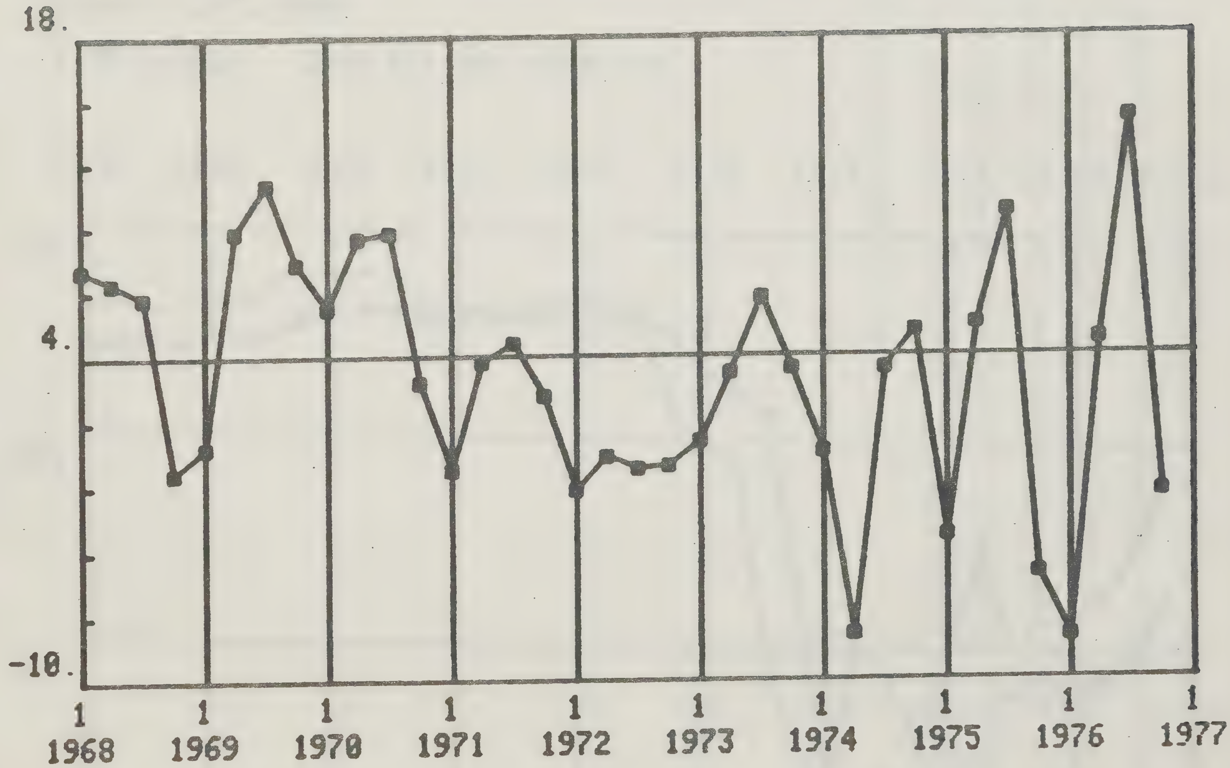
TIME BOUNDS: 1968 1ST TO 1976 4TH

SYMBOL SCALE NAME

■	#1	EXPWH3	CANADIAN EXPORT PRICE
●	#1	EXPWH4	U.S. GULF PORTS PRICE

FIGURE 2.2

Montreal Barley - Chicago Corn Price Differential



TIME BOUNDS: 1968 1ST TO 1976 4TH

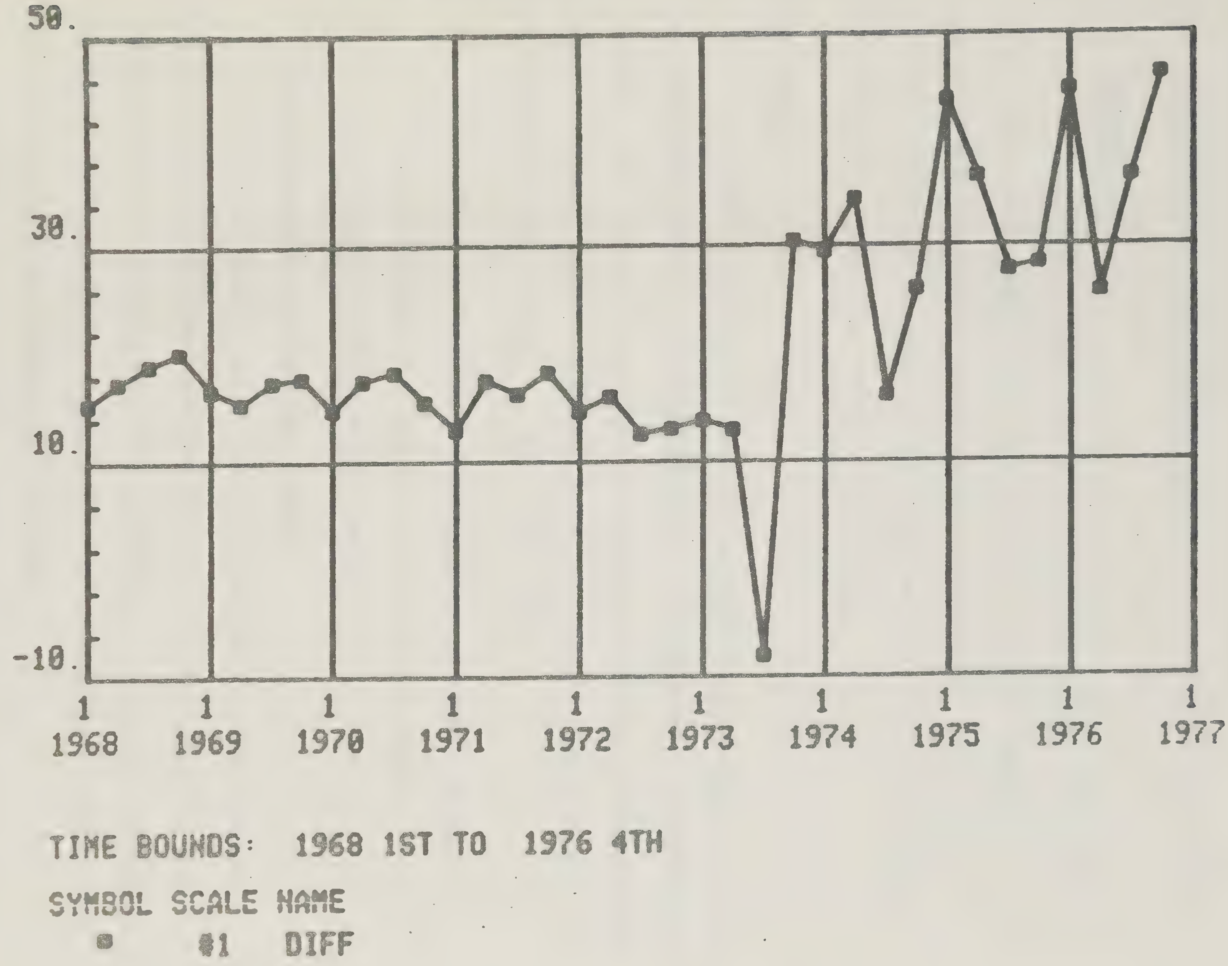
SYMBOL SCALE NAME

■ #1 MTLD

FIGURE 2.3

The Montreal Barley - Off-Board Farm

Barley Price Differential



3.0 THEORETICAL AND METHODOLIGICAL ISSUES

3.1 INTRODUCTION

The purpose of this section is to present a brief synopsis of the theoretical concepts that form the basis for the econometric model outlined in Section 4 and presented in Section 5. The review focuses on the theory relevant to the econometric estimation of demand, inventory, price and price linkage relationships.

3.2 DEMAND

The theoretical basis for this component model is some variant of the competitive model of price determination. Consequently, the estimation of demand is of critical importance in modelling historical price movements. There are three categories of demand functions specified and estimated in the behavioural relationships of this grains model:

(a) food and industrial demand - normal consumer demand;

(b) feed demand by livestock - derived input demand;

(c) foreign demand - excess demand.

Food and Industrial (Consumer) Demand

The relationship used to explain food and industrial demand for grains derives from consumer demand theory. Demand theory is based on the maximization of consumer utility subject to an appropriate budget constraint. Solution of the maximization problem through differentiation leads to a set of demand equations of the form

$$(3.1)\quad n_{it} = f_i\ (P_{it}, P_{jt}, \ldots P_{nt}, Y_t, Z_t)\ i = 1, \ldots, n$$

which relate consumption of a commodity n_{it} to its price P_{it}, the prices

of other commodities P_{it} ..., P_{nt}, income Y_t and other variables Z_t. There are many considerations which are relevant to the above equation including a set of underlying restrictions such as the Homogeneity, Engel aggregation, Cournet aggregation, Symmetry and Slutsky conditions. These conditions impose restrictions on complete demand systems so that the estimated functions satisfy several important relationships and can be appraised. The selection of a functional form is not an issue here since every function is estimated linear in the variables and any non-linearities in the system is to be incorporated through varying parameters. Dynamic adjustments in consumer demand to changes in demand variables can be incorporated through habit persistance, adaptive expectations or state adjustment formulations.

Livestock Feed (Derived) Demand

The demand for grain as feed depends on conditions in the final product market, supply conditions and prices for other inputs, and the production relationship between inputs and output. The theoretical derivation of factor demand and its properties are well documented throughout the literature (Bronfenbrenner (1961), Henderson and Quandt (1958)). Feed demand is derived from the underlying demand for livestock. Assuming competitive conditions in both factor and product markets, (where the marginal cost of feeding grains is equal to the price of livestock) the demand for feed grains is the marginal value product curve, where the marginal physical product of the input multiplied by the product price equals the input price. This is represented as MVPo in Figure 3.1 below. This case assumes three conditions as you move along the MVPo curve.

. . . /17

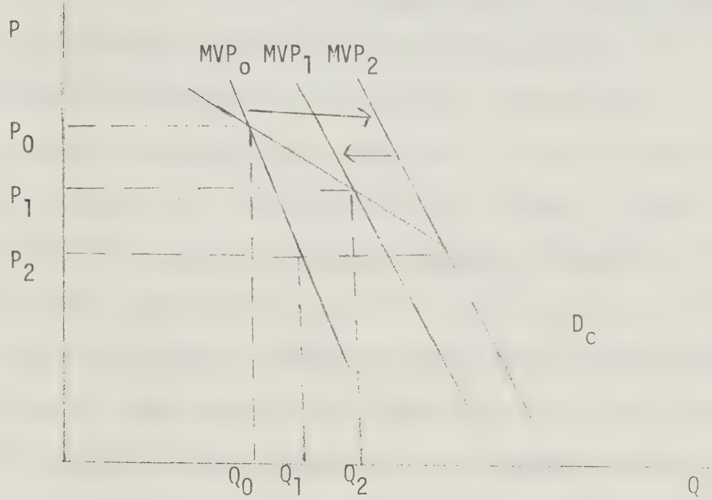
(1) theprices for livestock and hence output levels remain constant,

(2) prices of other inputs and hence quantitaties employed remain unaltered,

(3) the technical relationship between inputs and output (the production function) remains the same.

FIGURE 3.1

Deyiation of Demand for Feed Grains



Initially, decline in the price of feed grains from Po to P_1 will involve a movement down the MVPo curve to Q_1, given the previous three assumptions. However, a decline in the feed grains price (say brought about by increased supplies) causes the marginal product of substitute inputs to decrease and the marginal product of complementary inputs to increase, thereby shifting MVPo to MVP_2. Meanwhile, the quantity of livestock output will increase due to the decline in feed grain prices, causing output prices to fall and a resulting shift left of MVP_2 to MVP_1. The resulting demand curve for feed grains is Dc. This demand curve will shift in response to changes

in prices of other inputs either substitutes or complements as well as to changes in output and product prices. Similarly, changes in the technological relationships between inputs and outputs will change the marginal product at each input level and therefore shifts the feed grain demand curve. Examples of changes in these technological relationships are changing feeding rates, carcass weights and feed conversion rates in livestock production.

Import/Export (Excess) Demand

It is recognized that wheat and feed grain prices are determined largely in international markets, particularly given the heavy reliance on world markets by the U.S. and Canada for their grain outlets. A complete set of quarterly supply and demand equations for all countries in the world is preferrable. However, data limitations, size of the model and the effort required would prohibit such an approach. Severe economic and methodological problems in specifying, estimating and simulating commodity models have confronted economic researchers in adapting models to reflect developments in international markets. (Labys (1975)). Most empirical research in international trade for agricultural products has been carried out with spatial price equilibrium models (Schmitz 1977)). Schmitz points out that one of the major problems with this approach is that it is extremely difficult to estimate the interrelationships among wheat, feed grains and livestock production. In addition, it is recognized that government interventions have a pervasive impact on international grain trade. Although the role of government policy in affecting international trade is not explicitly taken into account in this study, the specification of excess demand curves lends itself readily to accommodate

effects of domestic and government policy variables on trade. Consequently, this study estimates directly import demand for each of Canadian and U.S. wheat and feed grains.

The specification and estimation of excess demand functions is primarily an extension of conventional demand analysis. However, Leamer and Stern (1970) distinguish two cases with regard to import demand relationships. The distinction is based on whether or not imports and domestic goods are perfect substitutes. If they are not perfect substitutes, then the specifications is analogous to conventional demand analysis given in the following equation.

(3.2) $M = f(a, y, Pm, Py)$,

where,

M equals the level of aggregate imports;

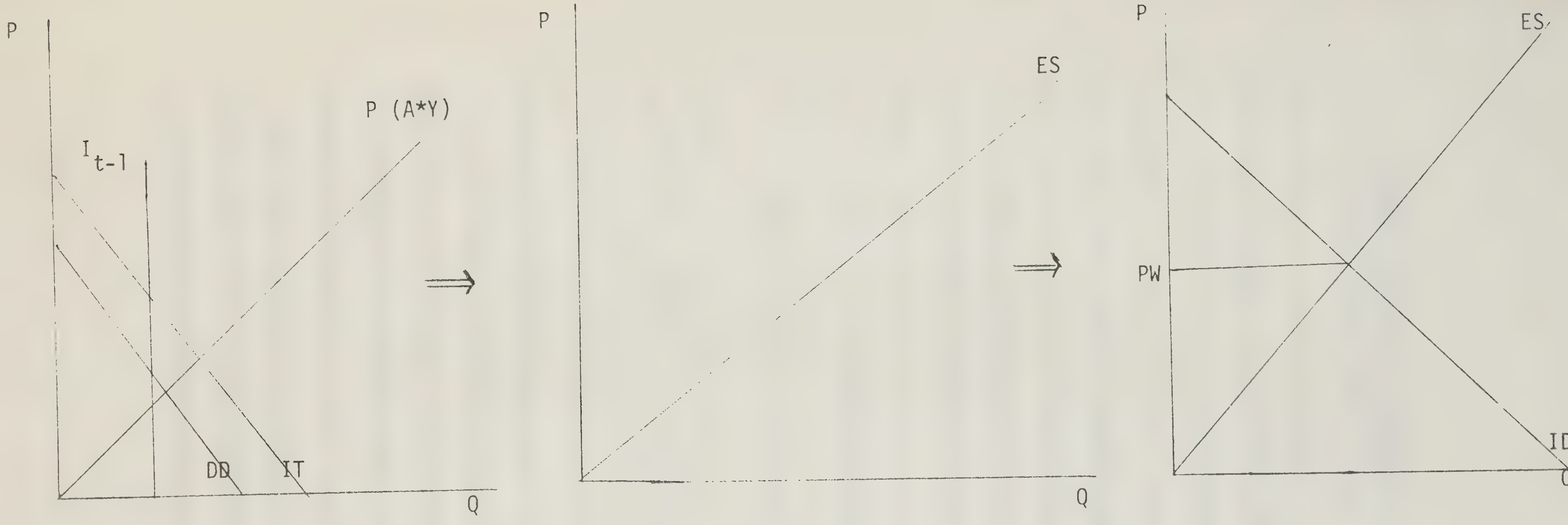
a is an intercept;

y is the level of income in the importing country;

Pm is the price of importables;

and, Py is the price of all other goods.

However, if importables are perfect substitutes for domestically produced goods (i.e. cross price elasticities are very large) the specification of the import demand function should include domestic supply variables. This distinction is of critical importance in empirical work since in the above case, domestic supplies directly influence imports. In the former case, domestic supply influences imports only through its impact on domestic prices, and hence the inclusion of domestic supply variables is not required.



(a) (b) (c)

where I_t = ending inventories

I_{t-1} = beginning inventories

DD_t = domestic demand

ES = export supply

ID = import demand

P = production

Y = yield

A = acreage

PW = world price

The above equation is modified therefore for excess demand for wheat:

(3.3) $M = f\ (PW, PØG, PS, QW, IW, Y)$

where
- M = aggregate imports
- P_W = price of wheat
- $PØG$ = price of other grains
- PS = price of soybean meal
- QW = production of wheat in importing region
- IW = beginning stocks of wheat in importing region
- Y = income in importing region

For feed grains, livestock production should be in place of income in equation 3.8 above.

There are many other factors affecting world demand for North American exports which are not specified explicitly in equation 3.3. Changes in exchange rates between exporting and importing region are incorporated by denominating all prices in equation 3.8 in SDR's, a trade weighted exchange rate of major international currencies. The effect of government policies in importing regions on import demand is not accounted for explicitly in the above formulation. Their imports are implicitly incorporated in the parameter capturing the reaction of domestic prices to world prices and through the intercept and other parameters of variables specified. Bredahl (1976) and Johnson (1975) have shown that this aspect has far reaching impacts on trade whilst Abbot (1979) has proposed an empirical framework to deal with it.

Several market rigidities are inherent in the marketing system which may affect import flows. Some factors which introduce rigidity into trade patterns are preferential arrangements, institutional features, contracts and commercial relations with other regions (whether it be the U.S. or the CWB). Trade share rigidity may be due to habit, and/or trade loyalities to particular products or sellers. Risk may also be a factor since buyers who frequently switch suppliers could incur fixed transaction costs and so it may be cheaper for the trader to pay a higher price to a stable supplier. Market aberrations are incurred with dock strikes, poor forward contracting facilities, shipping constraints and the like. Some of these factors can be captured through dummy variables.

One individual excess demand functions are estimated, market shares of world trade can be derived and so are implicitly endogenous.

The prices used in the excess demand functions are all denominated in SDR's, a trade weighted index of foreign currency values. In this way, the impact of changes in currency value on foreign demand for U.S. and Canadian grains are explicitly incorporated in the analysis.

3.3 COMMODITY INVENTORIES

The quarterly allocation of grain stocks is of critical importance in this model since ending quarterly stocks are the only source of supply for the ensuing quarter. Consequently, for distributing supplies between crop harvests.

Inventory accumulation is normally associated with 3 basic motives: transaction, speculative and precautionary. Transactions demand for stocks refers to the trade-off between cost of holding

inventories (value of which could be invested) and the cost of no inventories (foregoing sales). Consequently, firms determine the optimal level of inventories, given the interest rate and cost of inventory holding. Speculative demand for stocks occurs when firms expect prices to change and/or a change of supply in the future. Precautionary demand refers to unexpected changes in production and/or demand so that firms can still meet their market commitments.

The most common models of inventory behaviour include the accelerator, flexible accelerator and the buffer-stock models. Each of these are explained in detail by Labys (1975), Evans (1969) and will not be developed here. Essentially, the accelerator model postulates that inventories vary directly and proportionately with output.

(3.9) $I_t = \alpha Q_t$ where I_t = ending inventories

Q_t = production

and $Q < \alpha < 1$

This model is developed to include modifications for partial adjustment of inventories to production, desired vs actual levels of inventories, sharp changes in output, price expectations, unfilled orders, and buffer stock motives.

Consequently, the ending inventories of grains can be specified as a function of production (transaction and precautionary demand), disappearance in previous quarter (transaction demand) futures prices (speculative demand) interest rate (opportunity or transaction cost) and the lagged dependent variable (stickiness effect).

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3.4 PRICE DETERMINATION

Since the primary objective in this study is to explain grain price movements, a discussion on price determination in commodity markets is in order. Labys (1975) points out that commodity price theory has received scant attention as an area separate from normal demand or equilibrium theory. He attributes this to three factors; first, if price forecasting is the goal, reliance has been on statistical or pragmatic price relationships; second, price relationships have been simply derived by inverting or normalizing a demand equation; and third, an explicit price relationship has been avoided by deriving prices from a reduced form. Heien (1977) echoes this theme and relates commodity price relationships to that of macro model price behaviour where wages and output determine prices. He adds that the traditional supply and demand models, where the prices fall out of the identity, place too much emphasis on the stock equation as an equilibrium condition. Consequently, prices are expressed as a function of total availability of the commodity and total disappearance.

Figure 3.2 displays the method by which the world price of wheat and feed grains is derived. The resolution of total U.S. and Canadian beginning and ending inventories, domestic disappearance and production (part (a) in Figure 3.2) gives total excess supply (part (b) in Figure 3.3). The interaction of excess supply and import demand solves for the world price (part (c) in Figure 3.2). All farm, wholesale, CWB fixed, Canadian export, and world import prices are simultaneously determined with this world price through the specification of price linkage equations. Some concepts in constructing price linkage or transmission functions are now discussed.

3.5 PRICE LINKAGE EQUATIONS

As described in Section 2, there are several market levels of prices for Canada which must be linked to world prices, namely Canadian farm, wholesale and export prices for each of barley, oats, wheat and corn.

(a) Wholesale Barley, Oats and Wheat Prices - Chicago Corn Price Differentials in Montreal

Prices for feed grains in Montreal were set in relation to Chicago corn prices by the CWB prior to 1974. Since 1974, only a portion of grain sales to Eastern Canada from Western Canada are under the authority of the CWB. Therefore, factors which affect the price spread between each grain, includes the CWB pricing decisions and the purchasing decisions of feed grain users.

In a perfect market, differentials between feed grain prices should be explained by the composition of the grain in terms of nutrients (protein, energy, etc.) modified by the behaviour of feed grain purchasers,

consumer preferences for output, and the given 'mix' of livestock class. However, examination of Western Canadian feed grain - Montreal corn price spreads exhibit variations which appear not to be attributable to these factors alone.

Consequently, five important categories of explanation for price variability between feed grain prices in wholesale markets are identified. These are:

(1) market structure (notably the CWB and possibly large grain traders who hold grain positions in Eastern transfer elevators);

(2) seasonality and market aberrations, particularly during the harvest season and close of navigation;

(3) supplies of and demand for feed grains in Eastern Canada;

(4) supplies of feed grains, relative to livestock production in Western Canada; and

(5) prices of high protein feeds, livestock mix, consumer preferences for meat and other technical and behavioural aspects.

(b) Farm-Wholesale Price Margins for Barley, Oats, Wheat and Corn

The primary factors affecting these price relationships are the demand and supply conditions on farms, which are indirectly controlled by the CWB through the imposition of delivery quotas. Therefore, these prices bear no direct relationship to either wholesale or export prices when quotas or transportation facilities are a constraint to grain movements.

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(c) Canadian Export Prices

These prices are set by the CWB in relation to world prices. The CWB presumably sets its price by taking into account of such factors as the prevailing and expected international grain prices, the volume of exports already committed, the availability of grain for domestic and export consumption, and the ability of the grain transportation and handling systems to move additional quantities of grain for export.

4.0 THE MODEL STRUCTURE

4.1 AN OVERVIEW OF THE ECONOMETRIC MODEL

In this section, a brief overview is given on the macro-components of the econometric model to follow.

The major structural components estimated for each of the wheat and feed grain sectors are given in Figure 4.1. Each component in the Canadian portion of Figure 4.1 is estimated for barley, oats and wheat. In the U.S. portion of Figure 4.1, each component is estimated individually for feed grains (aggregation of oats, barley, sorghum and corn) and wheat. Production is the only component in Figure 4.1 that is exogenous in the econometric model. These components represented in Figure 4.1 are estimated along with two price determining equations (world price of feed grains and wheat) and many price linkage equations, the latter of which includes Canadian farm, wholesale, CWB initial and final prices, and export prices.

The econometric model developed is a simple linear model designed to give local approximations to the true system. Rausser and Johnson (1978) argue that many economic relationships are not linear

but that complex non-linear structural specifications are inadequate for many forecasting purposes. The structural changes experienced in agriculture during the 1970's has magnified the poor performance of both linear and non-linear representations of traditional agricultural econometric models. Hence, they suggest that the model specification may as well be linear in the variables since there is little a priori information or theoretical foundations available to model builders concerning the choice of a functional form. The non-linear relationships or structural change could be incorporated with time-varying parameters. The choice of a linear model was the following advantages. First, statistical estimation is best suited for linear models and reduced forms of linear models are easily estimated, allowing analysis of the dynamic properties of the model. Second, reliability statistics are more easily generated from model forecasts and up-dating methods are more accessible for application to linear models. Parameter variation methods are not used in this study, nevertheless the models are estimated linearly in the variables. Non-linearity in parameters can be easily applied in further work. However, this would require considerable evaluation of the model relationships since Johnson states that one should not use variational parameter methods without strong a priori justification.

The econometric model can be conveniently sub-divided into twelve sub-sectors (Table 4.1). The first sub-sector contains the estimates of feed demand for each grain (or set of grains) in Canada and the U.S. The major exogenous variables in this block include livestock production and prices, and the price of soybean meal.

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The second sub-sector of the model is food and industrial demand for each grain in Canada and the U.S. The only exogenous variables in this case are per capita disposable income and population.

The third sub-sector is farmers marketings to the commercial elevator system (off-farm) of barley, oats and wheat in Canada. As noted earlier, these equations are important in determining the availability of grains for export and food use, and the remaining grains on the farm determine largely the farm prices and levels of farm inventories.

The fourth sub-sector contains the closing inventory equations for each grain in Canada and the U.S. These equations are vital in determining the world prices of wheat and corn, and are critical in the price linkage equations for Canadian farm, wholesale and export grain prices. The major exogenous variables are the futures price, grain production, loan rates in the U.S. and opportunity cost variables (interest rate for U.S. total and Canadian commercial stocks; livestock prices for Canadian farm stocks).

The fifth sub-sector is the import demand equations for each region of Canada (oats, barley, wheat) and the U.S. (wheat and total feed grains). These equations are critical in determining the world prices of wheat and corn. The major exogenous variables include grain production and beginning inventories in both the U.S.S.R. and the R.O.W., livestock production in the U.S.S.R. and income in the R.O.W.

The sixth sub-sector (sub-sector F in Table 4.1) is the equations determining Canadian export prices of barley, oats and wheat.

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As mentioned earlier, these prices are set by the CWB and hence the equations involve the modelling of those economic variables which are thought to be those to which the CWB react in setting export prices.

The seventh sub-sector is the world import prices for Canadian barley and wheat, and U.S. wheat and corn. These prices are simply the export prices denominated in special drawing rights (SDR's) converted to the local currency. These prices are in the import demand equations contained in the fifth sub-sector.

The eighth sub-sector contains price linkage equations of Canadian wholesale grain markets. These prices are in part controlled by the CWB and hence are greatly influenced by world prices and the domestic supply situation of each grain.

The ninth sub-sector is the Canadian farm or off-board prices. These prices are estimated as a function of export prices, wholesale prices and the levels of farm inventories, all of which reflect the level of export sales and supply pressures affecting farm prices.

The tenth sub-sector includes the CWB controlled initial and final pool farm prices. These prices are also farm prices in that the CWB pays farmers for the grain sold for export and food and industrial demand. These prices are distinct from those farm prices in sub-sector nine which are prices determined by the farm supply (farm inventories) and farm demand (feed and seed) and are not directly related to either export or wholesale prices (with the exception of the Chatham corn price).

The eleventh sub-sector contains two balancing identities which are simply an aggregation of several endogenous and exogenous variables fed into other stochastic equations.

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The final sub-sector are two equations from which the world price of wheat and corn are determined. The world price of wheat in U.S. dollars (U.S. gulf ports) is specified as a function of total availability of wheat in Canada and the U.S. and of total Canadian and U.S. exports. The world price of corn in U.S. dollars (Chicago) is determined through the supply/disposition identity of total U.S. feed grains.

The model estimates outlined above contain fifty-three endogenous variables and fifty-four exogenous variables. In Section 5, a detailed description of the behavioural equations and their statistical properties are given.

FIGURE 4.1

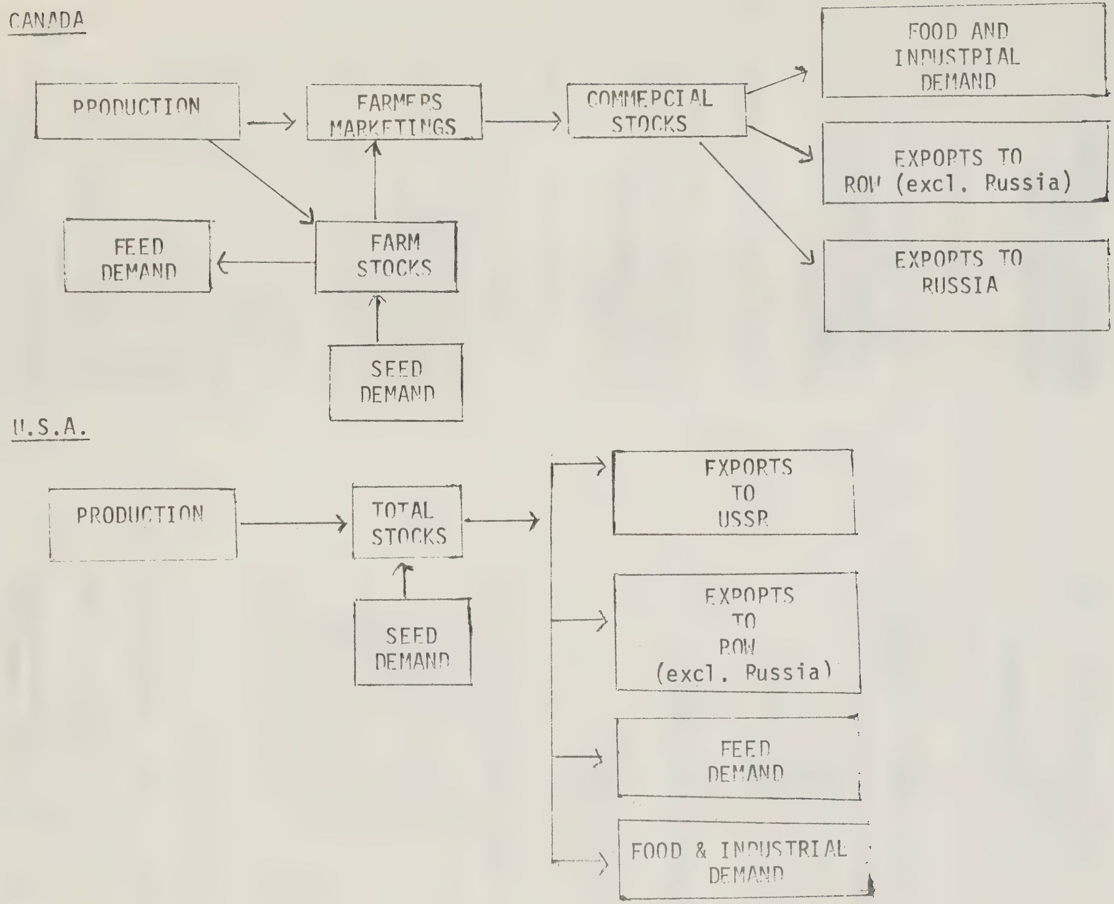
CANADA
PRODUCTION
FARMERS MARKETINGS
COMMERCIAL STOCKS
FOOD AND INDUSTRIAL DEMAND
EXPORTS TO ROW (excl. Russia)
EXPORTS TO RUSSIA
FARM STOCKS
FEED DEMAND
SEED DEMAND
U.S.A.
PRODUCTION
TOTAL STOCKS
SEED DEMAND
EXPORTS TO USSR
EXPORTS TO ROW (excl. Russia)
FEED DEMAND
FOOD & INDUSTRIAL DEMAND

TABLE 4.1

An Overview of the Model

ENDOGENOUS VARIABLES	EXOGENOUS VARIABLES[a]
1. FEED DEMAND	
1. Cdn barley 2. Cdn oats 3. Cdn wheat 4. U.S. feed grains[b] 5. U.S. wheat	Livestock Production Livestock Price Soybean Meal Price
2. FOOD & INDUSTRIAL DEMAND	
6. Cdn barley 7. Cdn oats 8. Cdn wheat 9. U.S. feed grains 10. U.S. wheat	Per Capita Disposable Income Population
3. FARMERS MARKETINGS	
11. Cdn barley 12. Cdn oats 13. Cdn wheat	Grain Production Seed Use
4. ENDING INVENTORIES	
14. Cdn farm stks barley 15. Cdn farm stks oats 16. Cdn farm stks wheat 17. Cdn com. stks barley 18. Cdn com. stks oats 19. Cdn com. stks wheat 20. U.S. stks feed grains 21. U.S. total stks wheat	Futures Prices Interest Rate Livestock Price[c] Grain Production Loan Rates U.S.
5. IMPORT DEMAND	
22. Cdn feed grain[d] exports ROW (excl. USSR) 23. Cdn wheat exports ROW (excl. USSR) 24. U.S. feed grain exports ROW 25. U.S. wheat exports ROW (excl. USSR)	ROW Income ROW Grain Production ROW Grain Stocks USSR Livestock production USSR Grain Production USSR Grain Stocks

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26. Cdn feed grain exports USSR	Soybean Meal Price
27. Cdn meat exports USSR	Futures prices
28. U.S. wheat exports USSR	

6. CANADIAN EXPORT PRICES

29. Cdn barley export price	Grain Production
30. Cdn oats export price	
31. Cdn wheat export price	

7. WORLD IMPORT PRICES

32. Wld barley price Cdn	
33. Wld wheat price Cdn	SDR rates
34. Wld corn price U.S.	
35. Wld wheat price U.S.	

8. CANADIAN WHOLESALE PRICES

36. Montreal corn price	US/CDN Exchange Rate
37. Montreal feed wheat price	
38. Montreal barley price	
39. Montreal oat price	

9. CANADIAN FARM PRICES

40. Corn price Chatham	Grain production
41. Off-Bd barley price	Transportation rates
42. Off-Bd oat price	
43. Off-Bd wheat price	

10. CWB FIXED PRICES

44. Initial price barley
45. Initial price oats
46. Initial price wheat
47. Final pool price barley
48. Final pool price oats
49. Final pool price wheat

11. BALANCING IDENTITIES

50. Total availability of Cdn & U.S. wheat	U.S. Wheat Production
51. Total Cdn and U.S. wheat exports	Cdn Wheat Production

. PRICE DETERMINING EQUATIONS

52. World price of wheat (U.S. Gulf Ports)	U.S. Feed Grain Production
53. World price of corn (Chicago)	U.S. Feed Grain Seed Use

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a/ Trend and dummy variables have been omitted from the list of exogenous variables.

b/ U.S. feed grains are an aggregation of corn, oats, barley and sorghum.

c/ Livestock price used as an opportunity cost for Canadian farm stocks of oats, barley and wheat only.

SECTION 5

The Econometric Model Results

5.0 INTRODUCTION

In this section, the specification and estimation of each equation outlined in the overview of the last section are given and discussed. The discussion begins with feed demand in sub-sector one and proceeds through each sub-sector, in order given before, and finishes with the discussion on the price determination equations for the world wheat and corn prices. All of the equations are estimated in linear form using ordinary least squares with the estimation period as 1967Q4 to 1976Q4. The coefficient of determination (RSQ) and the Durbin-Watson statistic (DW) are presented in the tables to follow, as are the coefficients, the student "t" values (in parentheses) and elasticities [in square brackets].

5.1 FEED DEMAND EQUATIONS

In section 3, feed demand was hypothesized to be a derived demand was hypothesized to be a derived demand and theoretically a function of the quantity and price of final output, the price of the product and the price of substitutes. Table 5.1 displays the regression results for each of the five feed demand equations. Specifically, feed demand was regressed as a function of its own price (farm price for Canada and world prices for the U.S.), the price of substitutes (soymeal in the U.S. equations and an alternative feed grain in the Canadian functions), livestock production and livestock product price indices, and a dummy variable (for Canadian equations) representing a change in feed grain policy of inter-provincial movements of feed grains.

All of the variables included in Table 5.1 have the expected signs with the exception of livestock price in equations 2 and 4 and livestock price in equation 3. However, each of these latter variables is statistically insignificant. A direct comparison of the elasticity estimates are not possible since quarterly estimates have not been published elsewhere. However, the elasticity values vary considerably. This may be due to the situation in the past in Canada whereby CWB quota policies coupled with excess supplies and weak export demand forced huge supplies on the farm and caused abnormal feeding conditions. In the U.S., wheat used for feed is sporadic and the data reported by the U.S.D.A. is derived from a residual, explaining its poor results.

5.2 FOOD AND INDUSTRIAL DEMAND EQUATIONS

Table 5.2 indicates that food and industrial demand is related to its own price, per capita disposable income and population. Income elasticities are all positive except for Canadian wheat. The price elasticity for food and industrial use is extremely inelastic. The The poor statistical fits for Canadian oats and barley may be due to the data whereby the disappearance data reported by Statistics Canada includes that used for feed by feed mill operations.

5.3 FARMER MARKETING EQUATIONS

Farmers marketings in this model are determined endogenously through an identity, rather than specifying a stochastic equation. Essentially, farmers marketings contain a supply element (farmers willingness to market) and a demand element (CWB's ability to sell grain domestically or in the export markets and consequent adjustment in

marketing quotas). Consequently, farmers marketings in Canada for each grain can be specified from two different identities.

(a) Marketings = Beginning commercial inventories - Ending commercial inventories - Domestic food and industrial demand - Export demand

or

(b) Marketings = Production + Beginning farm inventories - Feed demand - Seed demand - Ending farm inventories

Since the CWB largely controls marketing quotas, through adjustments in commercial inventories and sales, it can be seen that once the CWB decides on how much grain is expected to be sold in export demand and domestic markets, and achieve desired levels of commercial inventories, the marketings are predetermined and the quotas are adjusted accordingly. This logic allows either equation of the form given in (a) and (b) to be used. As shown in Table 5.3, the equations used in the model are of the form in (a) above.

5.4 ENDING INVENTORY EQUATIONS

Stock equation for Canada are disaggregated into CWB influenced wholesale or commercial stocks and farm stocks. However, government owned and controlled stocks are not differentiated from privately held stocks in the U.S.

The results for Canadian farm and commercial inventories are shown in Table 5.4. Farm stocks are a function of the off-board farm

price and commercial stocks are a function of the Canadian export price. Given the unique situation of farm inventories discussed earlier, it is hypothesized that livestock prices are the relevant opportunity cost to farmers. The sign on the basis variables (futures price minus cash) are inconsistent and generally insignificant. Speculative demand for farm stocks are probably non-existent between quarters within a crop year and only marginal for carry-over between years. Some of the results are quite good in terms of the RSQ but work must be done in determining the motives of the CWB in holding the desired levels of commercial inventories.

The U.S. inventory equations are shown in Table 5.5 and results indicate proper signs and significant t ratios.

5.5 IMPORT DEMAND EQUATIONS

Import demand functions are generally specified to be a function of the own import price (own export price denominated in SDR's), import price of the same grain of a different exporting country, import price of a close substitute (soymeal), levels of grain production and beginning inventories in the importing region, the level of income and livestock production in the importing region, and the basis, representing expectations.

The world prices are denominated in a world trade weighted exchange rate (SDR rate) so that import demand is affected by the cost facing importers in their currencies. The shortfalls of grain production in importing regions are incorporated through the grain production and beginning stocks variables of the importing regions. Changes in demand (incomes) in importing regions are captured through the trend variable, ROW income and livestock production (in USSR). The speculative behaviour

of importers is captured with the basis variable and the effect of alternative grains available to importers is incorporated in each equation through the specification of other grain prices and/or soymeal prices.

The results of feed grain import demand equations are presented in Table 5.6. In general, the direct and cross price effects are quite significant as are the levels of grain production and inventories in importing regions. Similarly, the results for the import demand functions of wheat are given in Table 5.7 and the general observations are similar to those given above for feed grains.

5.6 CANADIAN EXPORT PRICE EQUATIONS

The export price is hypothesized to be a function of the world price (in Canadian dollars) and the lagged export price. Therefore, it is assumed the CWB sets its price in relation to the world price (determined by Canadian and U.S. production and inventories coupled with ROW import demand and domestic disappearance) and to the price in which they set it in the previous period. In addition, the export price is specifi ed to be a function of total supplies (i.e. opening farm inventories plus grain production.) That is, as the level of commercial inventories rise, the CWB is exporting less and hence sets the export price at higher levels.

The results are presented in Table 5.8. The beginning commercial inventory variables all have positive signs whilst production and farm inventories are negative except in the export price of wheat equation.

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5.7 WORLD IMPORT PRICE EQUATIONS

World import prices are simply the U.S. and Canadian export prices denominated in SDR's. Since the model is linear, the import prices are specified as a function of the SDR rate, time and the export price. The equation estimates are given in Table 5.9.

5.8 CANADIAN WHOLESALE PRICE EQUATIONS

The prices of feed wheat, oats and barley in Montreal and the price of corn in Chatham are specified as a function of the price of U.S. corn in Montreal, lagged dependent variable, and the beginning levels of farm and commercial inventories.

5.9 CANADIAN FARM PRICE EQUATIONS

Farm prices are regressed on Canadian export prices, Montreal wholesale prices, beginning farm stocks and the lagged dependent variable. In other words, the farm price equations are price linkage equations or reduced form representations. The results are presented in Table 5.11.

5.10 CWB FIXED PRICE EQUATIONS

There are two prices relevant to producers for their payment for grain marketed through the CWB, namely initial prices and final realized pool prices. The initial price is set by the government and can be termed a policy price. The final price is merely an accounting price in that it is a weighted average of the initial, domestic and export prices received for grain marketed through commercial channels. Both of these prices are payments to the farmer for grain marketed under quota to the CWB which is sold on both the domestic and export markets.

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The initial price is announced in the first calendar quarter preceding the crop year and is in effect at the beginning of each crop year approximately the third quarter). The government is considered to set the initial price in relation to current and anticipated world prices, the domestic and world supply situation, export movements in the past, and expected sales. (Although normally the CWB has an estimate of marketing commitments for general quarters in advance.) The initial price is usually a conservative figure in that if it is too high, the government must pay the deficit. In subsequent quarters, the initial price may be increased if the first level is obviously too low in relation to current sales. Likewise, there is political pressure by producers to raise the initial price, particularly if past trends in world export prices are increasing. The CWB is less inclined to change initial prices in response to inflation of production costs since farmers are compensated through stabilization programs (WGSA). The total payment is simply an accounting identity, once the pool is closed. Given the initial prices, final payments are made in relation to total receipts by the CWB for domestic and export sales, less marketing and administration costs. The total payment is assumed to be made in the first calendar quarter following the end of the crop year.

The initial prices are specified as a function of the initial price last year and last quarter, and the difference between the last quarter value and the current export price. The rationale is that the CWB will attempt to keep initial prices in line with export prices on a conservative basis so as to give a final payment. The three quarter

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lag on the export price is used because the initial price effective for the beginning of the crop year is announced two quarters in advance. The final price is expressed as a function of the export price lagged three to six quarters, corresponding to the pool year to which the final price represents. Final prices are also a function of exports lagged six quarters so as to obtain a weight for the volume of exports. The results are presented in Table 5.12.

5.11 BALANCING IDENTITIES

There are two equations for wheat in the model which aggregate several endogenous and exogenous variables and are then fed into other stochastic equations. They are:

(50) Total Availability = Beginning Cdn Farm Stocks +
Beginning Cdn Com. Stocks +
Beginning U.S. Total Stocks +
Cdn Production + U.S. Production

(51) Total Exports = Cdn Exports U.S.S.R. + Cdn Exports ROW +
U.S. Exports, U.S.S.R. + U.S. Exports ROW

5.12 PRICE DETERMINING EQUATIONS

The price of wheat is specified as an explicit price relationship (similar to an inverted inventory equation) whereby the world price of wheat is a function of total availability of wheat (total Canadian and U.S. wheat production and beginning stocks) and a function of total wheat exports by the U.S. and Canada to the ROW. Conversely, the price of corn in Chicago is determined through the supply/disposition identity for feed grains and is derived from a reduced form. This latter method was

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attempted for wheat also but did not work as well. A possible explanation for this may be that wheat disappearance in North America is proportionally higher in export markets than feed grains. Consequently, wheat prices are more dependent on world market developments, the latter of which is naively and simplistically modelled in this presentation.

The price determining equation for the world wheat price is given in Table 5.13. Seasonal slope coefficients are given for the total wheat available variables. As wheat availability rises, export price declines and conversely for changes in total wheat exports on the export price.

The identity equation determining the Chicago price of corn is as follows:

(53) U.S. Feedgrain Production + Beginning U.S. Feedgrain Stocks + U.S. Feedgrain imports = Ending U.S. Feedgrain Stocks + Total U.S. Feedgrain Exports + U.S. Feedgrain Food Disposition + U.S. Feedgrain Disposition + U.S. Feedgrain Seed Disposition

TABLE 5.1

FEED DEMAND EQUATION ESTIMATES 1/

	Eq'n #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	Off-bd. Barley Price	Off-bd. Oat Price	Off-bd. Wheat Price	U.S. Corn Price	U.S. Wheat Price	U.S. Soymeal Price	Lvstk. Prod'n	Lvstk. Price	Policy Dummy 2/		LAG DEP	RSQ	D.W.
							$/M.T.	$/M.T.	$/M.T.	$/M.T.	$/M.T.	$/M.T.	INDEX	INDEX	BINARY		M.M.T.		
Canada Barley	1	M.M.T.	-.10 (-.27)	-.26 (-5.9)	-.61 (-9.0)	-.47 (-7.0)	-.00133 (-.96) [-.073]						.009 (1.33) [.52]	.0479 (.37) [.042]	.0018 (.02) [.0003]		.92 (15.3) [.9]	.94	1.26
Canada Oats	2	M.M.T.	.55 (1.8)	-.189 (-3.9)	-.52 (-8.0)	-.46 (-8.3)		-.004 (-1.9) [-.21]	.002 (.88) [.07]				.003 (.6) [.18]	-.08 (-.7) [-.08]	.06 (.7) [.02]		.71 (6.8)	95	1.39
Canada Wheat	3	M.M.T.	.34 (1.7)	-.088 (-3.5)	-.10 (2.6)	-.06 (-1.59)			-.002 (-2.8) [-.47]				-.005 (1.4) [-.98]	.19 (2.6) [.67]	.07 1.2 [.08]		.92 (5.7)	78	1.23
U.S. Fd. Grns.	4	M.M.T.	32.3 (1.69)	-4.7 (-3.5)	-10.6 (-5.9)	-14.7 (-11.5)				-.24 (-5.14) [-.55]	.158 (5.0) [.45]	.025 (2.3) [.07]	9.18 (1.25) [5.5]	-.44 (-1.9) [-.41]				90	1.17
U.S.3/ Wheat	5	M.M.T.	.38 (.11)	.51 (1.2)	-.31 (-.72)	1.5 (2.4)					-.004 (-.6) [-.6]	.002 (-.5) [-.001]	.043 (.21) [1.2]	-.014 (-29) [-.06]			.39 (2.05)	72	2.16

1/ Coefficient is given first, t - statistic in paranthesis, elasticity in square brackets.

2/ CWB restricted inter-provincial movement of feed grains prior to August, 1973.

3/ Endogenous through the U.S. wheat supply disposition identity in the model.

(28/5/79)

TABLE 5.2

FOOD AND INDUSTRIAL DEMAND EQUATION ESTIMATES

	Eq'n #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Per Capita Income	Cdn. Per Capita Income	U.S. Corn Price	Cdn. Wheat Export Price	U.S. Wheat Price	Cdn. Barley Export Price	Cdn. Oat Export Price	U.S. Pop'n.	Cdn. Pop'n.		LAG DEP	RSQ	D.W.
							$1,000 /HD	$1,000 /HD	$/tonne	$/tonne	$/tonne	$/tonne	$/tonne	Mill.	Mill.		M.M.T.		
Canada Barley	6	M.M.T.	.37 (.17)	-.08 (-1.23)	.147 (.4)	-.21 (-2.25)		5.9^{-5} (.17) [.42]				5.9^{-4} (.51) [.38]			3.1^{-4} (.002) [.056]		-.02 (-.13	60	2.07
Canada Oats	7	M.M.T.	-.22 (-.16)	.001 (.03)	-.001 (-.04)	-.13 (-2.86)		$.8^{-5}$ (.077) [.12]				-5.8^{-4} (-.55) [-.33]			.017 (.26) [3.0]		.157 (.93)	44	2.12
Canada Wheat	8	M.M.T.	-30.7 (-2.7)	.041 (.17)	.40 (1.76)	.14 (.48)		-.0028 (-1.9) [-4.92]		-.002 (-.74) [-.47]					1.54 (2.7) [68.4]		.3 (1.7)	66	2.05
U.S. Feed Grains	9	M.M.T.	2.28 (24.0)	.054 (.9)	.094 (1.6)	.264 (4.4)	5.6^{-6} (7.79) [.33]		-.0015 (-1.11) [-.031]									84	2.52
U.S. Wheat	10	M.M.T.	3.35 (41.9)	-.15 (-3.4)	-.327 (-7.3)	-.076 (-1.7)	2.1^{-6} (4.1) [.12]				-6.3 (-1.16) [-.0002]							74	1.78

1/ Total income for equation # 9 and 10.

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TABLE 5.3

FARMERS' MARKETINGS EQUATIONS

Unites - Million Metric Tonnes

	Equation #		
Canadian Barley	11	=	Production + Beginning farm stocks - Feed Demand - Seed demand - Ending farm stocks.
Canadian Oats	12	=	" " "
Canadian Wheat	13	=	" " "

TABLE 5.4

CANADIAN ENDINC INVENTORIES EQUATION ESTIMATES

	Eq'n #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	Off-Bd. Price Cdn.	Lvstk. Price	Prod'n.	Basis 1/	Cdn. Export Price	Farm Stocks & Prod'n.	Strike Dummy	Policy Dummy 2/	Policy Dummy 3/		LAG DEP	RSQ	D.W.
							$/tonne	INDEX	M.M.T.	$/tonne	$/tonne	M.M.T.					M.M.T.		
Canadian Farm Barley	14	M.M.T.	1.66 (1.87	-.29 (-1.1)	-1.6 (-3.9)	-.05 (-.05)	.002 (.17) [.0014]	-.81 (-1.1) [-.14]	.78 (9.2) [.28]	-.01 (-.4) [-.02]					-.06 (-.1) [-.004]		.64 (9.7)	42	1.60
Canadian Farm Oats	15	M.M.T.	-.91 (-1.4) -.25	-.19 (-1.75) -.13	-.32 (-1.46) -.02	-.72 (-1.56) -.05	.004 (.94) .06	.16 (.78) .05	1.13 (13.8) .38	.007 (.84) .02					-.184 (-.98) -.02		.87 (10.8)	99	1.17
Canadian Farm Wheat	16	M.M.T.	-2.6 (-.79)	1.26 (2.32)	-.62 (-.88)	-1.26 (-.81)	.013 (.45) [.05]	-2.04 (-1.21) [-.15]	1.04 (10.3) [.27]	-.002 (-.18) [-.003]					-.12 (-.06) [-.003]		1.01 (11.5)	98	1.95
Canadiam Commercial Barley	17	M.M.T.	-.68 (-.88)	.25 (1.57)	.22 (.99)	-.31 (-1.94)				-.01 (-1.25) [-.079]	.005 (.86) [.20]	.113 (3.01) [.53]	.15 (.40) [.052]	2.28^{-6} (2.07) [.019]			.44 (3.12)	77	2.25
Canadian Commerical Oats	18	M.M.T.	.16 (.64)	.02 (.45)	.017 (.21)	.068 (1.38)				.003 (.74) [.085]	-5.2^{-4} (-.43) [-.109]	.008 (4.8) [.10]	-.035 (-.57) [-.065]	-1.13^{-7} (-.39) [-.005]			.61 (3.65)	54	1.81
Canadian Commerical Wheat	19	M.M.T.	-2.77 (-1.09)	.149 (.33)	.195 (.36)	.08 (.16)				-.002 (-.27) [-.004]	.0094 (.82) [.13]	.1 (1.89) [.24]	.61 (.51) [.05]	4.3^{-6} (1.28) [.009]			.88 (9.38)	93	1.83

1/ Basis represents the MS corn futures price in Chicago in CDN $ minus the U.S. corn price in Montreal for equations 14, 15, 17, 18.

2/ For equations 16 and 19, basis is the Chicago wheat futures price in CDN $ minus Canadian export price for wheat. Temporary Wheat Reserve Act Payments vinary variable.

3/ Change in CWB policy for inter-provincial grain movements.

TABLE 5.5

U.S. ENDING INVENTORY EQUATION ESTIMATES

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Corn Price	U.S. Corn Loan Rate	U.S. Fd. grn. Prod'n.	Basis	U.S. Interest Rate	U.S. Wheat Price	U.S. Wheat Loan Rate	U.S. Wheat Prod'n.			LAG DEP	RSQ	D.W.
							$/tonne	$/tonne	M.M.T.	$/tonne		$/tonne					M.M.T.		
U.S. Feed Grains	20	M.M.T.	18.3 (2.12)	-5.6 (-.8)	-15.9 (-2.5)	-19.9 (-3.7)	-.31 (-1.68) [-.25]	.21 (1.22) [.10]	.65 (14.9) [.31]	.12 (.66) [.09]	.60 (1.63) [.03]						.60 (12.5)	99	1.91
U.S. Wheat	21	M.M.T.	-1.67 (-.40)	-1.29 (-1.2)	-3.3 (-1.9)	-3.75 (-.94				.072 (1.24) [.016]	.23 (1.03) [.042]	-.043 (-5.4) [-.134]	.10 (2.45) [.152]	.86 (8.87) [.301]			.77 (10.4)	99	.82

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TABLE 5.6

FEED GRAIN IMPORT DEMAND

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Corn Import Price	Cdn. Barley Import Price	Time	Basis	U.S. Soymeal Import Price	Importer Fd. Grn. Prod'n.	Importer Fd. Grn. Stks.	Row Income	U.S. Wheat Import Price	USSR Policy Dummy	LAG DEP	RSQ	D.W.
							SDR/ tonne	SDR/ tonne		$/tonne	SDR/ tonne	M.M.T.	M.M.T.	Bill $	M.M.T.	Binary	M.M.T.		
Cdn. Fd. Grn. to Row (excl. USSR)	22	M.M.T.	-.39 (-.22)	-.45 (-3.3)	.05 (.27)	-.05 (-.3) [.198]	.0022 (.36) [-1.03]	-.011 (-2.13) [1.7]	.028 (1.79) [.009]	.022 (1.06) [-.017]	-.00.5 (-1.2) [.88]	1.17^{-6} (.4) [-.67]	-6.9^{-6} (-.69)		-032 (-1.62) [-.4]		.27 (1.5)	75	2.09
U.S. Fd. Grn. to Row (total)	24	M.M.T.	-.48 (-.05)	-.5 (-.65)	-.065 (.61)	.64 (.61)	-.25 (-2.00) [-2.48]			.182 (1.43) [1.83]	.014 (2.08) [.17]		4.1^{-5} (.78)	.031 (3.7) [1.37]				86	1.65
Cdn. Fd. Grn. to USSR	26	M.M.T.	1.19 (.70)	-.03 (-.6)	.008 (.14)	.017 (.29)	9.9 (.33) [.95]	3.2^{-5} (.016)				-.014 (-2.0) [-4.14]	-.005 (-1.01) [-.18]	-.63[1/] (-.48) [-11.34]		.08 (.9) [.55]	.20 (.97)	42	2.23

1/ USSR Livestock Production.

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TABLE 5.7

WHEAT IMPORT DEMAND EQUATION ESTIMATES

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Wheat Import Price	Cdn. Wheat Import Price	Basis	Row Wheat Prod'n.	Row Wheat Stks.	Time	U.S. Soymeal Import Price	U.S. Wheat Exports Row	Cdn. Wheat Exports Row	USSR Binary Dummy	LAG DEP	RSQ	D.W.
							$/tonne	$/tonne	$/tonne	M.M.T.	M.M.T.		M.M.T.	M.M.T.	M.M.T.	Binary	M.M.T.		
Cdn. Wheat Row (excl. USSR)	23	M.M.T.	3.86 (2.45)	-.74 (-.64)	.04 (.05)	.37 (1.25)	.027 (1.2) [.93]	-.024 (-1.0) [-.85]	-.023 (-1.1) [-.11]	.003 (.26) [.07]		-.024 (-1.45) [-.45]		-.124 (-1.42) [-.26]			.06 (.29)	61	1.79
U.S. Wheat Row (excl. USSR)	25	M.M.T.	6.18 (3.3)	1.92 (1.4)	4.1 (2.32)	-1.26 (-1.54)	.002 (2.5) [.32]		-.012 (-.27) [-.01]	-.06 (-2.63) [-.89]		.03 (.96) .31	.007 (1.57)		-.72 (-2.07) [-.33]		.112 (.69)	78	1.89
Cdn. Wheat USSR	27	M.M.T.	1.94 (1.37)	-.25 (-1.56)	-.010 (-.06)	-.02 (-.10)	.007 (1.48) [1.33]	-.012 (-2.89) [-2.39]		-.012 1/ (-1.01) [-.62]	-.05 1/ (-2.03) [-2.23]	.005 (.28) [.58]				.18 (.6) [.2]	.12 (.67)	58	2.21
U.S. Wheat USSR	28	M.M.T.	3.53 (2.4)	.12 (.69)	-.03 (-.14)	-.26 (-2.9)	-.017 (-2.98) [-2.34]	.001 (.23) [.25]		-.015 1/ (-.6) [-.88]	-.017 1/ (-1.36) [-1.05]	-.03 (-1.85) [-4.6]				1.56 (4.2)	.65 (4.7)	87	2.01

1/ USSR

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TABLE 5.8

CANADIAN EXPORT PRICE EQUATION ESTIMATES

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	Cdn. Whse. Oat Price	Cdn. Prod'n.	Policy Dummy	Cdn. Beg. Farm Stks.	Cdn. Beg. Comm. Stks.	Cdn. Whse. Barley Price	U.S. Wheat Price	Cdn./U.S. Exchge. Rate			LAG DEP	RSQ	D.W.
							$/tonne	M.M.T.	BINARY	M.M.T.	M.M.T.	$/tonne	$/tonne				M.M.T.		
Cdn. Barley	29	$/tonne	24.7 (1.78)	-4.6 (-.97)	-9.3 (-1.48)	-7.03 (-.42)		-3.8 (-.66) [-.03]	25.8 (2.44) [.12]	-1.62 (-1.34) [-.13]	5.2 (1.08) [.12]	.21 (1.3) [.021]					.46 (4.13)	97	2.54
Cdn. Oat	30	$/tonne	57.1 (1.9)	-4.7 (-.81)	-21.5 (-2.2)	-17.6 (-.6)	.048 (.31) [.047]	-2.13 (-.36) [-.04]	20.3 (1.96) [.105]	-6.2 (-1.79) [-.31]	18.1 (.83) [.086]						.46 (3.9)	93	2.07
Cdn. Wheat	31	$/tonne	68.7 (1.09)	5.6 (1.54)	6.3 (1.4)	-9.5 (-.89)		.81 (1.17) [.0289]	-6.33 (-.666) [-.022]	.59 (1.16) [.081]	3.39 (2.42) [.246]		.51 (6.7) [.47]	-125.3 (-1.9) [-1.177]			.74	99	1.62

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TABLE 5.9

WORLD IMPORT PRICE EQUATION ESTIMATES

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Corn Price	U.S. $ Per SDR	TIME	Cdn. Export Barley Price	Cdn. $ Per SDR	Cdn. Export Wheat Price	U.S. Wheat Price				LAG DEP	RSQ	D.W.
							$/tonne			$/tonne		$/tonne	$/tonne				M.M.T.		
Barley Cdn.	32	SDR's/ Tonne Cdn.	65.5 (12.2)	-.18 (-.32)	.12 (.20)	.17 (.29)			.02 (.62)	.87 (71.3)	-59.1 (-11.2) [-.93]							99	.44
Wheat Cdn.	33	SDR's/ Tonne Cdn.	84.2 (12.8)	-.185 (-.23)	.10 (.79)	.10 (.129)			.05 (1.16)		-76.1 (-11.49) [-.88]	.86 (83.2) [.97]						99	.44
Corn U.S.	34	SDR's/ Tonne U.S.	60.3 (25.5)	.24 (.80)	.397 (1.32)	.22 (.73)	.85 (105.5) [.94]	-58.5 (-20.1) [-.95]	.11 (5.5)									99	.71
Wheat U.S.	35	SDR's/ Tonne U.S.	69.2 (15.6)	-1.21 (-.45)	-.15 (-.31)	-.187 (-.39)		-64.1 (-11.4)	.095 (2.97)				.84 (99.0)					99	.47

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TABLE 5.10

CANADIAN WHOLESALE PRICE EQUATION ESTIMATES

	Eq'n. \#	UNITS	Seasonal Dummies A	JS1	JS2	JS3	U.S. Wheat Price	Cdn./ U.S. Exchge. Rate	Cdn. Comm. Stks.	Cdn. Farm Stks.	Policy[1/] Dummy	Trans. Rate	MTL Corn Price	U.S. Corn Price	TIME		.LAG DEP	RSQ	D.W.
							$/tonne		M.M.T.	M.M.T.	BINARY		$/tonne	$/tonne			M.M.T.		
MTL Corn	36	$/tonne	-97 (-3.4)	.51 (.32)	-2.67 (-2.54)	.13 (.12)		89.3 (3.99) [1.05]				-.71 (-1.89) [-.078]		1.06 (-15.4) [.91]	.36 (2.23)			99	1.74
MTL Feed Wheat	37	$/tonne	-19.9 (-.31)	3.2 (.94)	3.3 (.78)	6.7 (1.25)	.33 (4.93) [.34]	34.9 (.53) [.38]	-1.72 (-1.29) [-.14]	.52 (1.23) [.79]	5.7 (.56) [.22]						.50 (4.23)	98	1.72
MTL Barley	38	$/tonne	-8.1 (-1.89)	5.2 (1.96)	1.08 (.36)	2.28 (.53)			4.8 (1.97) [.105]	.64 (1.17) [.05]	7.16 (1.32) [.03]	-.54 (-1.23) [-.06]	.73 (8.97) [.76]				.18 (2.0)	99	1.52
MTL Oat	39	$/tonne	33.8 (2.0)	-.04 (-.01)	-8.1 (-1.3)	-15.0 (-1.66)			-38.4 (-2.6) [-.16]	-2.15 (-1.0) [-.093]	2.42 (.36) [.011]	-.03 (-.017) [-.001]	.52 (4.20) [.53]				.37 (2.73)	98	1.49

1/ Change in CWB marketing policy after 1974.

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TABLE 5.11 Canadian Farm Price Equation Estimates

	Eq'n. #	UNITS	Seasonal Dummies A	Seasonal Dummies JS1	Seasonal Dummies JS2	Seasonal Dummies JS3	Cdn Corn Prodn	Mtl Corn Pricg	Trans Cost	Mtl Barley Price	Cdn Farm Stks	Policy Dummy[1]	Cdn Export Price	Mtl Wheat Price	Mtl Oat Price		LAG DEP M.M.T.	RSQ	D.W.
Chatham Corn	40	$/tonne	1.6 (.74)	8.2 (4.07)	4.1 (2.6)	6.7 (1.07)	-.77 -.33 [-.007]	.82 (13.2) [-.96]	-1.48 (-4.3) [-.19]								.15 (2.01)	99	1.12
Off-bd Barley	41	$/tonne	4.6 (.59)	-3.53 (-1.26)	-4.7 (-1.28)	-9.13 (-1.68)				.52 (6.04)	-1.52 (-2.2) [-.17]	4.03 (.66) [.03]	.061 (.37) [.083]				.31 (1.54)	99	.43
Off-bd Oat	42	$/tonne	65 (5.6)	-10 (-4.2)	-23 (-5.6)	-38.2 (-6.1)					-9.7 (-6.4) [-.65]	11.3 (2.6) [.078]	-.117 (-2.06) [-.15]		.41 (7.8) [.675]		.20 (2.35)	99	1.24
Off-bd Wheat	43	$/tonne	29.2 (2.7)	-1.8 (-.74)	-4.3 (-1.5)	-1.09 (-2.8)					-1.19 (-4.1) [-.25]	15.2 (1.98) [.08]	-.037 (-.57) [-.05]	.34 (4.41) [.46]			.41 (3.18)	99	.68

1/ CWB policy change
2/ Montreal Wheat Price

TABLE 5.12 CWB Fixed Price Equation Estimates

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	Export Minus Initial Price	Initial Price t-4	Export Price t-3	Export Price t-4	Export Price t-5	Export Price t-6	Exports t-6	TIME			LAG DEP	RSQ	D.W.
							$/tonne	$/tonne	$/tonne	$/tonne	$/tonne	$/tonne	M. M.T.				M.M.T.		
Initial Barley		$/tonne	4.68 (.85)				.015 (.11) [.0035]	-.06 (-.38) [-.056]									.99 (8.5)	89	2.06
Initial Oats		$/tonne					-.08 (-1.4) [-.024]	.025 (.22) [.023]									1.01 (10.2)	96	1.84
Initial Wheat		$/tonne	10.05 (1.39)				.16 (1.48) [.003]	.139 (.71) [.127]									.71 (4.7)	83	1.84
Final Barley		$/tonne	-9.13 (-8.5)						.10 (1.77) [.109]	2.16 (20.7) [2.13]	-1.38 (-16.6) [-1.35]	-.12 (-4.08) [-.106]	11.6 (-18.3) [-.102]	.55 (23.1)				99	2.0
Final Oats		$/tonne	-139 (-12.7)						1.7 (8.1) [1.65]	2.1 (7.9) [2.3]	-3.3 (-6.8) [-3.06]	.72 (3.4) [.67]	190.3 (3.09) [.089]	1.7 (10.2)				99	2.00
Final Wheat		$/tonne	-11.7 (-3.2)						2.4 (6.8) [2.71]	-2.5 (-4.1) [-2.86]	1.25 (2.3) [1.32]	-.18 (-.76) [-.176]	-.35 (-1.06) [-.016]	.147 (2.86)				99	2.00

TABLE 5.13 World Wheat Price Equation (U.S. $/tonne)

	Eq'n. #	UNITS	Seasonal Dummies A	JS1	JS2	JS3	Total Avail Q1	Total Avail Q2	Total Avail Q3	Total Avail	Total Wheat Exports						LAG DEP	RSQ	D.W.
							M. M.T	M. M.T.	M. M.T.	M. M.T.	M. M.T						M.M.T.		
U.S. Wheat Export Price	52	M. M.T.	-54.7 (1.43)				-.04 (-.13) [-.005]	-.005 (-.02) [-.0004]	-.07 (-.74) [-.01]	-.12 (-.36) [-.07]	2.56 (4,07) [.69]						.76 (8.78)	92	2.15

6.0 THE EX POST SIMULATION RESULTS AND EX POST FORECAST ERRORS

6.1 INTRODUCTION

The foregoing model was simulated historically over the estimation period 1968Q2 to 1976Q4. The simulation used actual values of exogenous variables. The measure of model performance over the simulation period is the root mean square (RMS) percentage error. This is a measure of the deviation of simulated values from the historical series. This validation procedure of the model allows careful inspection of how well the model generates endogenous variables over the time period in which each equation was estimated. This procedure is in addition to the analysis of the statistical and economic properties of each equation given in the last section.

In order to check the predictive ability of the model outside its estimation period, a prediction interval test (ex post forecast) was conducted for 1977 Q1 and 1977 Q2 using known values of the exogenous variables and initial values of the lagged endogenous variables.

6.2 EX POST SIMULATION RESULTS

Before discussing the results of the RMS test for each sub-sector of endogenous variables, it may be useful to observe plots of the historical simulation between actual and generated values of key endogenous variables given in Figure 6.1 through 6.16.

The simulation results for the world wheat price is shown in Figure 6.1. The model missed turning points in the last two quarters each in 1974 and 1976, and severely under-predicted prices in 1974 1 and 1974 4. Otherwise, the model tracked actual prices quite closely

and consistently. However, wheat prices are generally under-predicted in the sharp wheat price rise during 1973/74 and over-predicted in the latter part of 1976. Figure 6.2 presents the corn price simulation results. All turning points were picked up but prices are under-predicted in 1973 4, 1974 2, 1974 3 and over predicted in the latter half of 1976.

Figure 6.3 through 6.6 present the simulation results for wheat and feed grain export demand from Canada and the U.S. U.S. wheat exports (Figure 6.3) simulates quite well, picking up most turning points, particularly in the last half of the simulation period. However, the Canadian wheat export demand equations (Figure 6.4) misses certain turning points and under-predicts exports in 1973 through 1975. U.S. and Canadian feed grain exports (Figure 6.5 and 6.6) simulate reasonably well although consistent turning point errors and prolonged periods of over and under-predictions are apparent.

Figures 6.7 through 6.9 present the simulation results for various inventory equations. U.S. feed grain inventories (Figure 6.7) simulate reasonably well as does Canadian farm inventories (Figure 6.9). However, commercial inventories in Canada did not simulate very well (an example is barley in Figure 6.8) reflecting the inadequate specifications of CWB stock holding motivations.

Figures6.10 and 6.11 display examples of feed demand and food and industrial demand simulations respectively in the U.S. These seem to perform rather inconsistent in tracking absolute levels of demand but most turning points are forecast.

Figure 6.12 gives an example of the farmer marketing equations (barley) simulations. These simulations perform poorly but is not

surprising given the fact it is calculated from an identity which tends to accumulate errors from both feed demand and farm inventories. In general however, the model did capture the major swings in marketings as shown in Figure 6.12.

Examples of Canadian export, wholesale and farm price simulations are given respectively in Figures 6.13 and 6.15. Large errors in simulation are apparent in each of these equations.

6.3 EVALUATION OF THE SIMULATION PERFORMANCE TEST

In Table 6.1, the simulation performance test statistic RMS is given for each equation of the model.

The feed demand equations perform rather well except for the U.S. feed wheat equation. However, these values are generated from the U.S. wheat supply/disposition identity and hence accumulate errors from equations in the model. In addition, the U.S.D.A. calculates feed wheat as a residual and hence the data are suspect.

Food and industry demand do not simulate well for Canadian barley, oats and wheat. This may be due to the quality of the data used in that it includes some grain used for feed by millers.

Farmers marketings simulated well under the circumstances that it is derived from the identity from which it accumulates the error from feed demand and farm inventory equations.

The poorest inventory equation simulations are the Canadian commercial stock functions. This is partially due to the simplistic specifications of these equations in modelling CWB desired inventory holdings but is also due to errors in the simulation of Canadian export prices.

The import demand equations are also weak, due mainly to errors derived from wheat and corn world prices and Canadian export prices.

The errors in the Canadian export price linkage equations are attributed to the inclusion of farm and commercial inventories in these equations. Errors in these latter variables plus those generated by the world wheat price, cause Canadian export prices to go array and initiate problems in other important equations of the model to simulate poorly, such as Canadian exports. Consequently, there are large RMS statistics for each of the Canadian farm and wholesale prices equations. This can be somewhat remedied by the exclusion of farm and commercial inventories in the export price linkage equations but would be gaining statistical improvement over a less sound structural representation of price determination.

The errors in the world price of wheat and corn is a culmination of errors in export and inventory equations.

6.4 EX POST FORECAST RESULTS

The results of the ex post forecasts for 1971Q1 and 1972Q2 are also given in Table 6.1. The error for the forecast of the world price of wheat is much lower than that for corn, a complete reversal from the simulation results. The largest errors are in exports, farmers marketings and Canadian food and industrial demand.

TABLE 6.1

Simulation and Forecast Results

	Simulation	Forecast Error	
	1968 2 to 1976 4 RMS*	Percentage 1977 1	1977 2
A. FEED DEMAND			
1. Cdn Barley	7	0	0
2. Cdn Oats	13	3	- 3
3. Cdn Wheat	47	3	32
4. U.S. Feed Grains	8	- 1	- 2
5. U.S. Wheat	1150	- 75	-284
B. FOOD & INDUSTRIAL DEMAND			
6. Cdn Barley	51	68	0
7. Cdn Oats	559	16	10
8. Cdn Wheat	84	117	- 4
9. U.S. Feed Grains	3	- 1	- 4
10. U.S. Wheat	2	0	5
C. FARMERS MARKETINGS			
11. Cdn Barley	45	- 9	- 15
12. Cdn Oats	76	69	108
13. Cdn Wheat	35	10	- 10
D. ENDING INVENTORIES			
14. Cdn Farm Stks Barley	12	- 5	- 12
15. Cdn Farm Stks Oats	8	- 4	- 18
16. Cdn Farm Stks Wheat	19	- 1	- 0
17. Cdn Com Stks Barley	15	23	40
18. Cdn Com Stks Oats	31	- 5	0
19. Cdn Com Stks Wheat	60	10	17
20. U.S. Total Stks Feed Grains	5	0	- 3
21. U.S. Total Stks Wheat	18	2	13

. . . /2

E. IMPORT DEMAND

22. Cdn Feed Grain Exports ROW (excl. USSR)	95	33	12
23. Cdn Wheat Exports ROW (excl. USSR)	22	- 32	- 32
24. U.S. Feed Grain Exports ROW (Total)	27	6	31
25. U.S. Wheat Exports ROW (excl. USSR)	240	15	7
26. Cdn Feed Grains Exports USSR	2.06[6]	N.A.	N.A.
27. Cdn Wheat Exports USSR	2442	66	68
28. U.S. Wheat Exports USSR	13796	9	49

F. CANADIAN EXPORT PRICES

29. Cdn Barley Export Price	10	8	2
30. Cdn Oat Export Price	9	8	0
31. Cdn Wheat Export Price	43	0	- 6

G. WORLD IMPORT PRICES

32. Wld Barley Price Cdn	10	8	4
33. Wld Wheat Price Cdn	40	0	- 6
34. Wld Corn Price U.S.	6	3	22
35. Wld Wheat Price U.S.	12	1	5

H. CANADIAN WHOLESALE PRICES

36. Montreal Corn Price	7	10	19
37. Montreal Feed Wheat Price	13	1	- 9
38. Montreal Barley Price	6	4	8
39. Montreal Oat Price	9	2	9

I. CANADIAN FARM PRICES

40. Corn Price Chatham	7	14	21
41. Off-bd Barley Price	15	7	12
42. Off-bd Oat Price	15	6	11
43. Off-bd Wheat Price	27	4	5

. . . /3

J. CWB FIXED PRICES

44. Initial Price Barley	30	- 1	- 2
45. Initial Price Oats	86	0	0
46. Initial Price Wheat	27	6	8
47. Final Pool Price Barley	22	4	N.A.
48. Final Pool Price Oats	19	5	N.A.
49. Final Pool Price Wheat	50	2	N.A.

K. BALANCING IDENTITIES

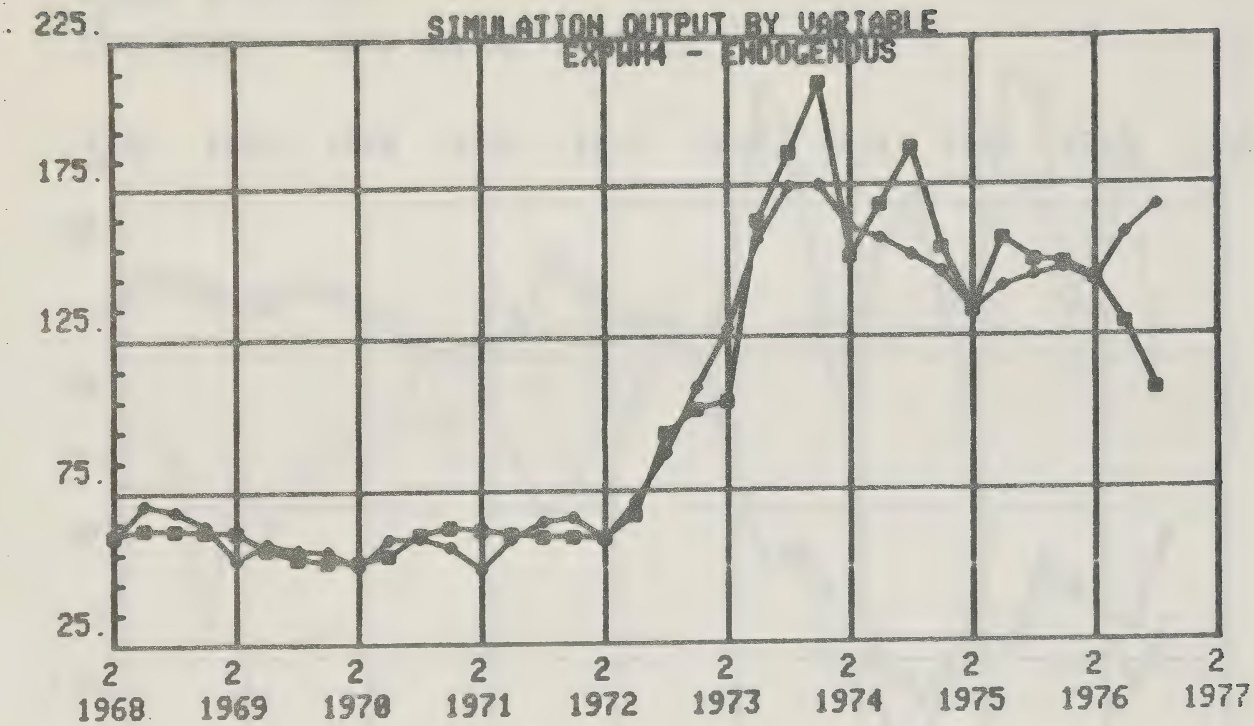
50. Total Availability of Cdn and U.S. Wheat	7	0	1
51. Total Cdn and U.S. Wheat Exports	13	0	1

L. PRICE DETERMINING EQUATIONS

52. World Price of Wheat (U.S. Gulf Ports)	13	0	5
53. World Price of Corn (Chicago)	6	3	21

*RMS represents root mean squared percentage error.

World Wheat Price, U.S. $ (U.S. Gulf Ports)

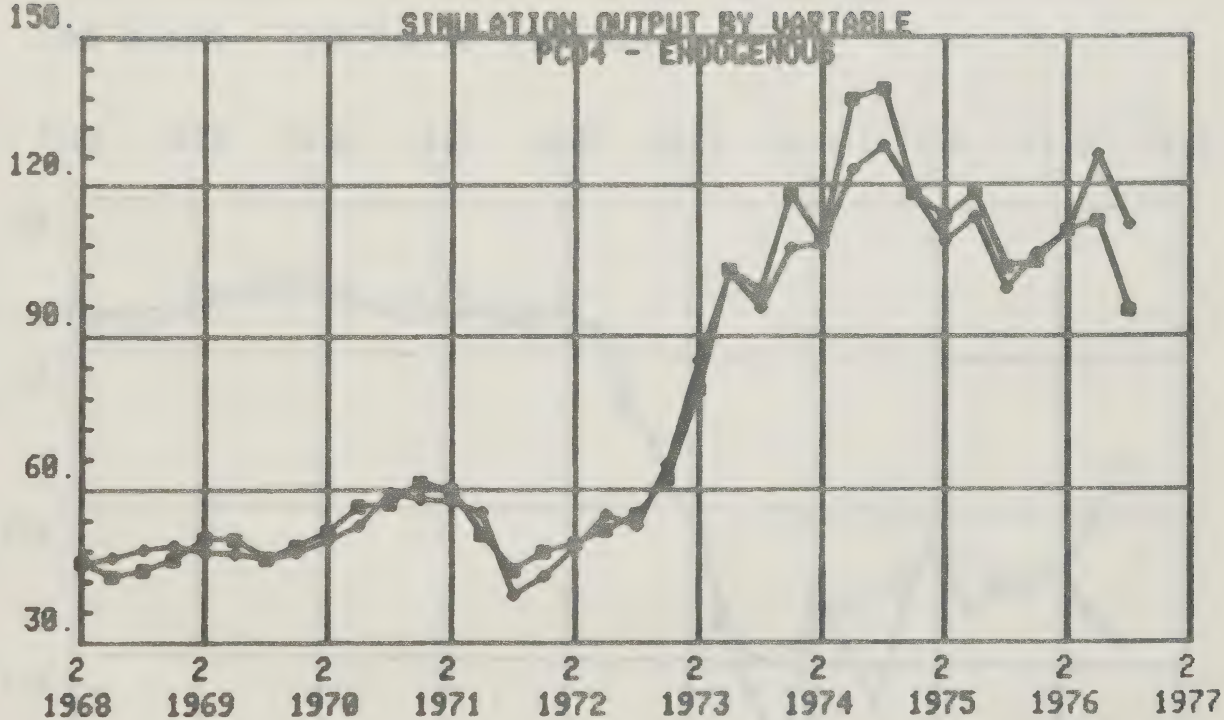


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
•	#1	GRNSIM1	SIMULATED

FIGURE 6.2

World Corn Price, U.S. $ (Chicago)



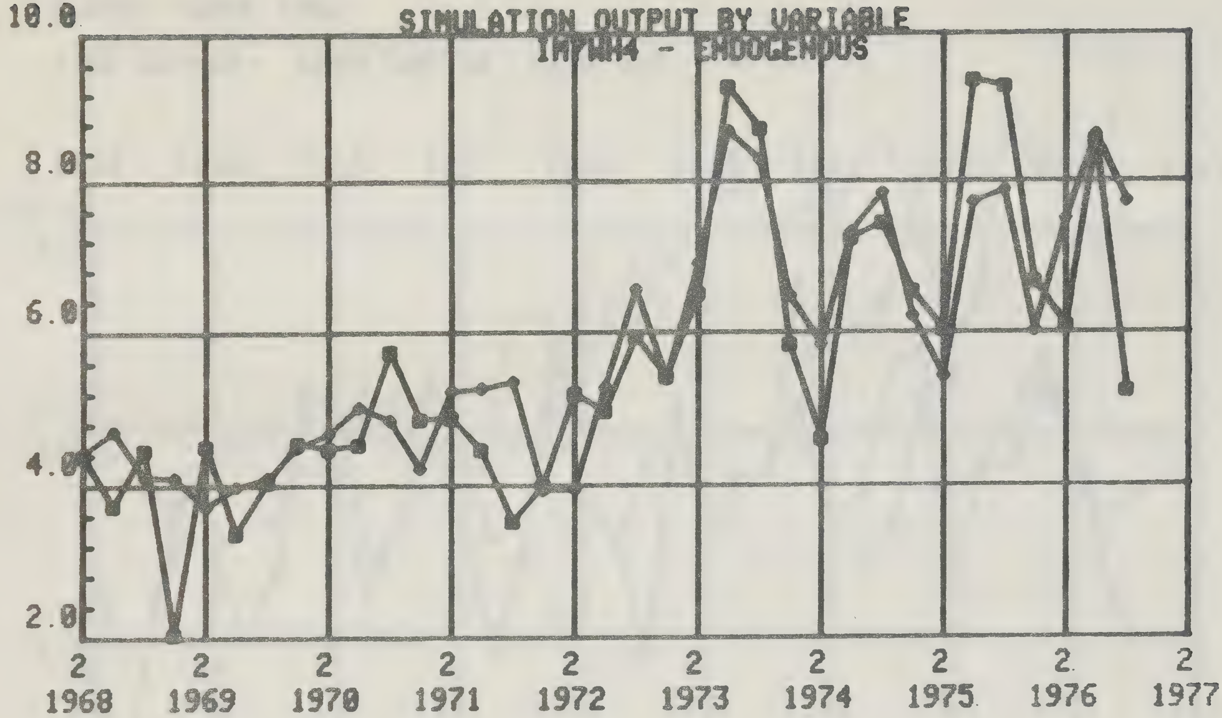
TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL SCALE NAME

■ #1 GRAIN ACTUAL

◆ #1 GRNSIM1 SIMULATED

U.S. Wheat Exports to ROW

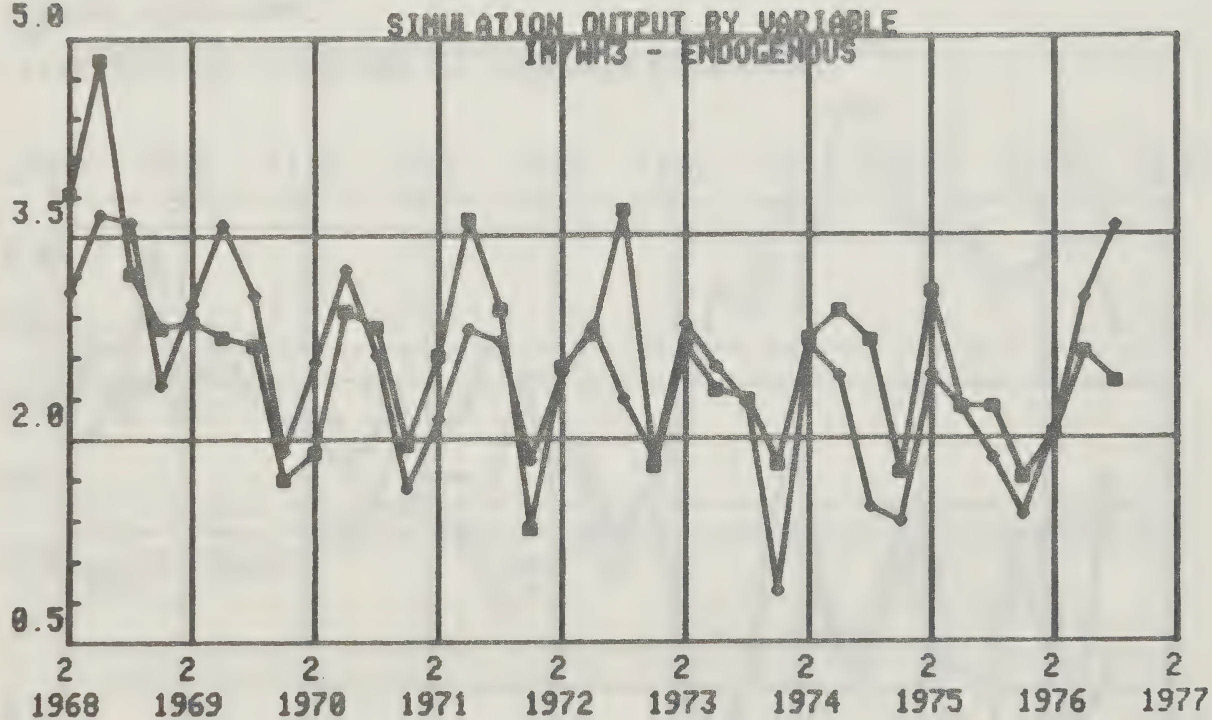


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
◆	#1	GRNSIM1	SIMULATED

FIGURE 6.4

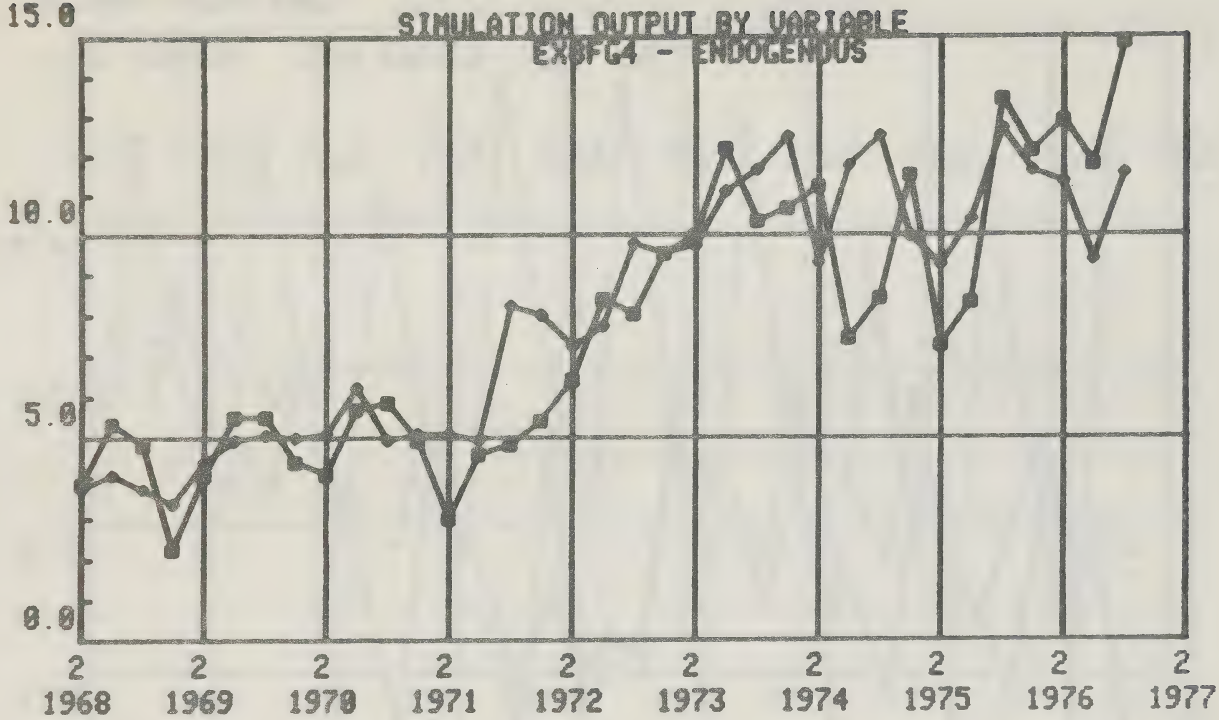
Canadian Wheat Exports to ROW



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

U.S. Feed Grain Exports to ROW

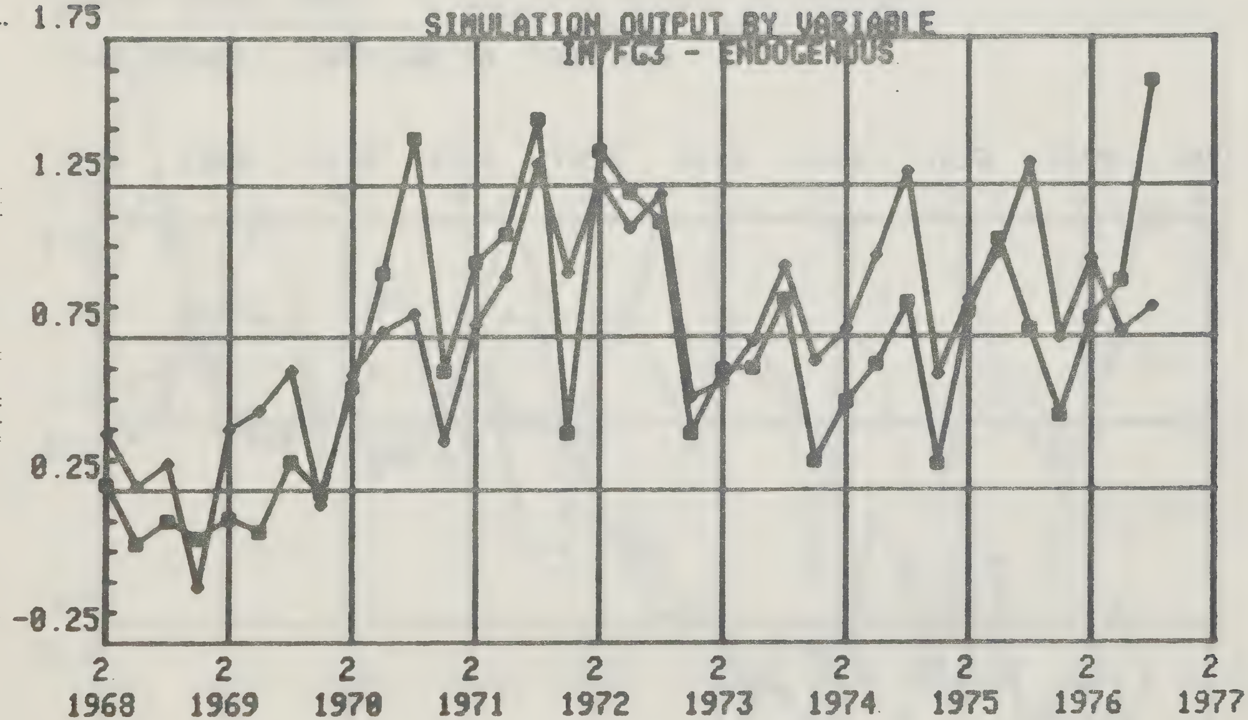


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

FIGURE 6.6

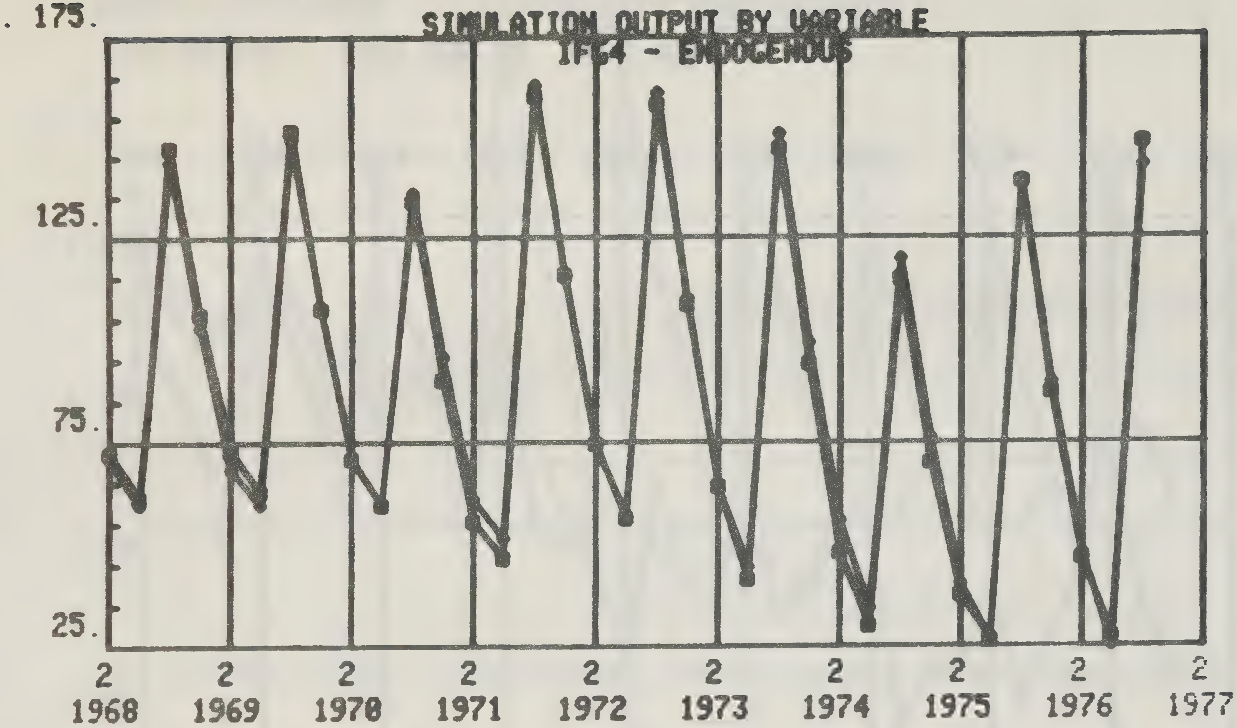
Canadian Feed Grain Exports to ROW



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

U.S. Feed Grains Total Ending Stocks

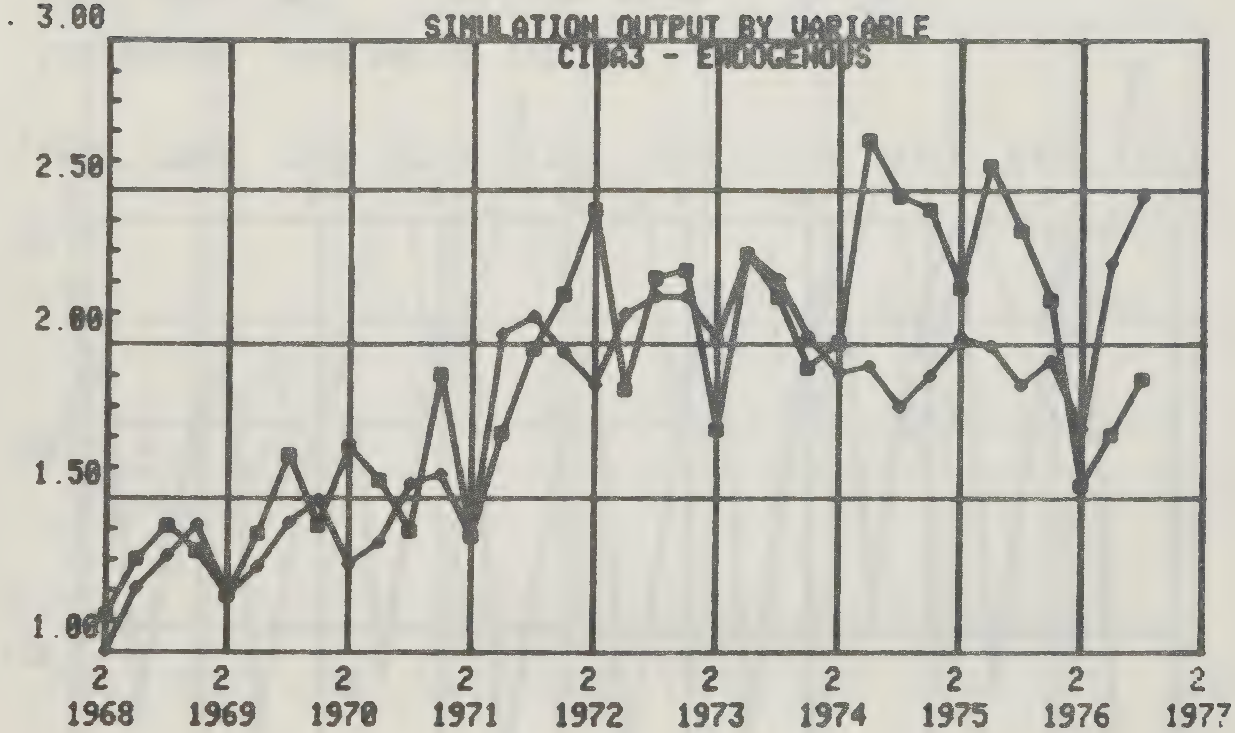


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

FIGURE 6.8

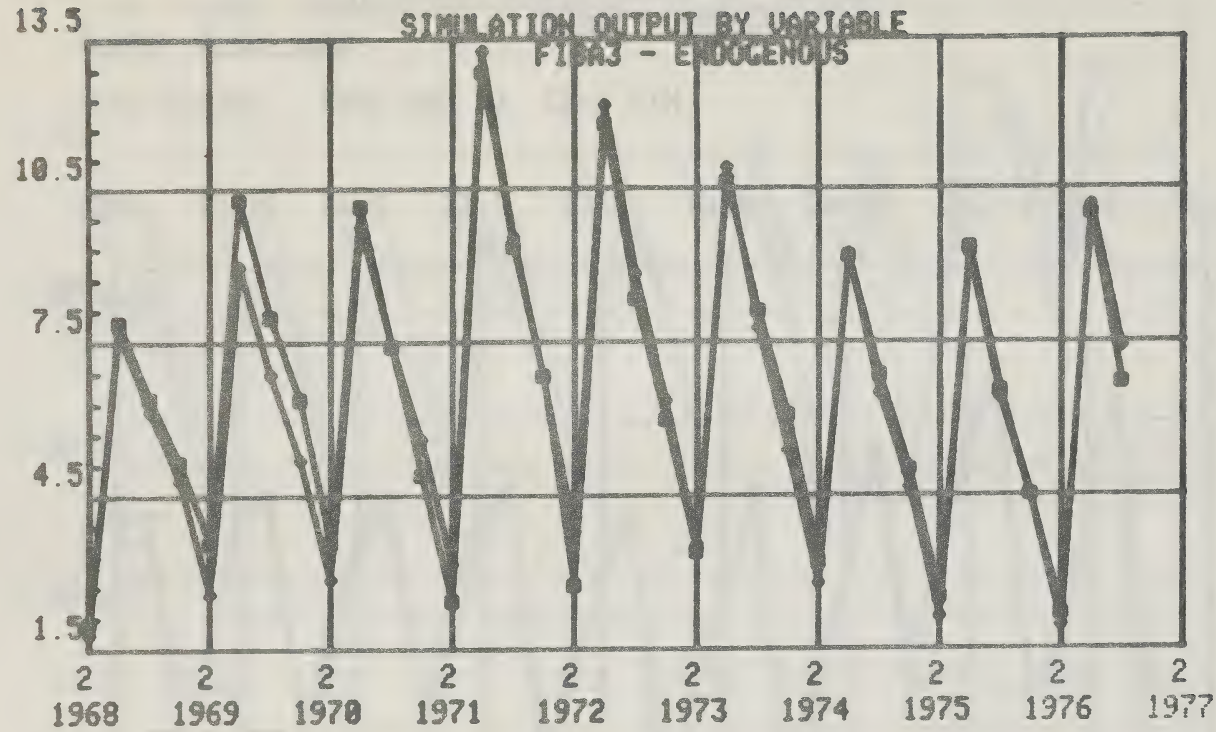
Canadian Commercial Barley Stocks



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

Canadian Farm Barley Stocks

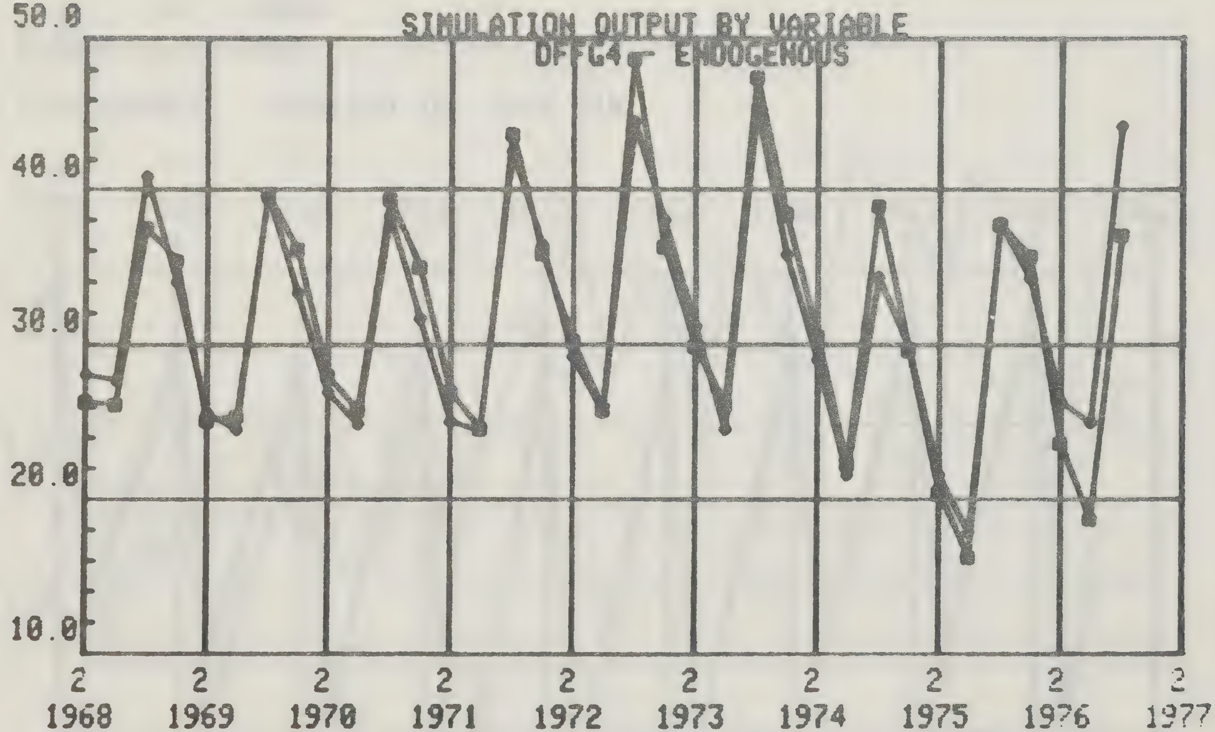


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
◆	#1	GRNSIM1	SIMULATED

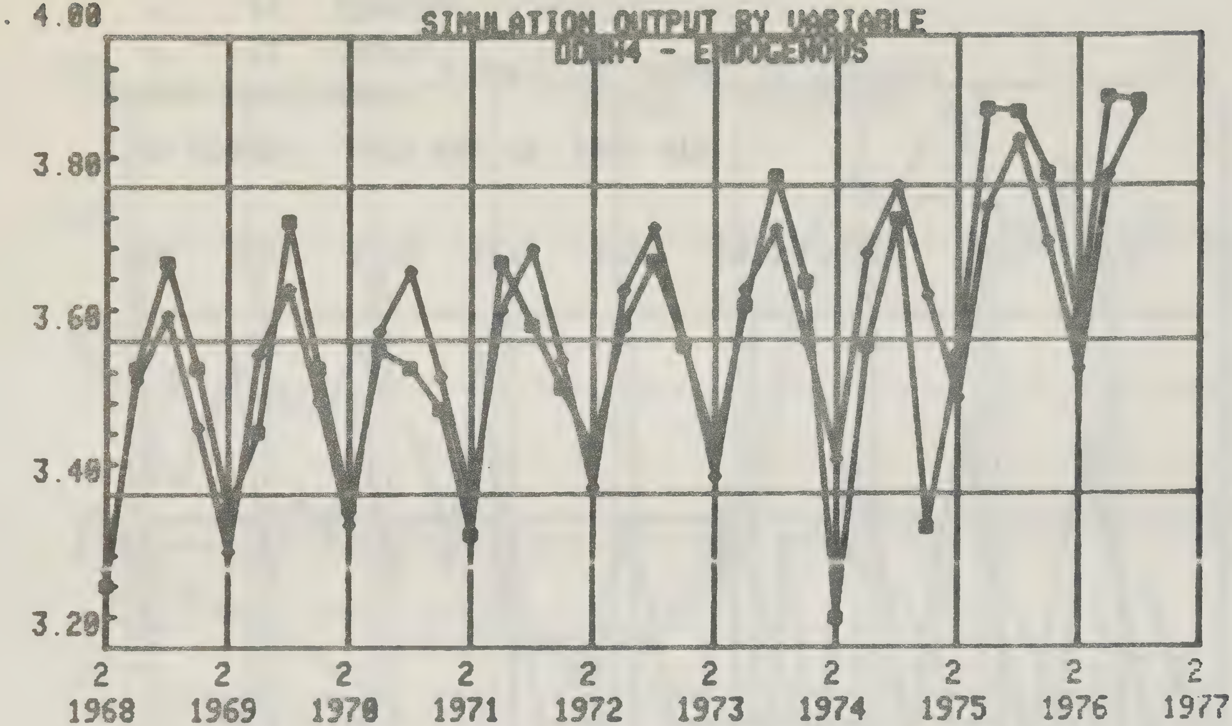
FIGURE 6.10

U.S. Feed Grain Feed Demand



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

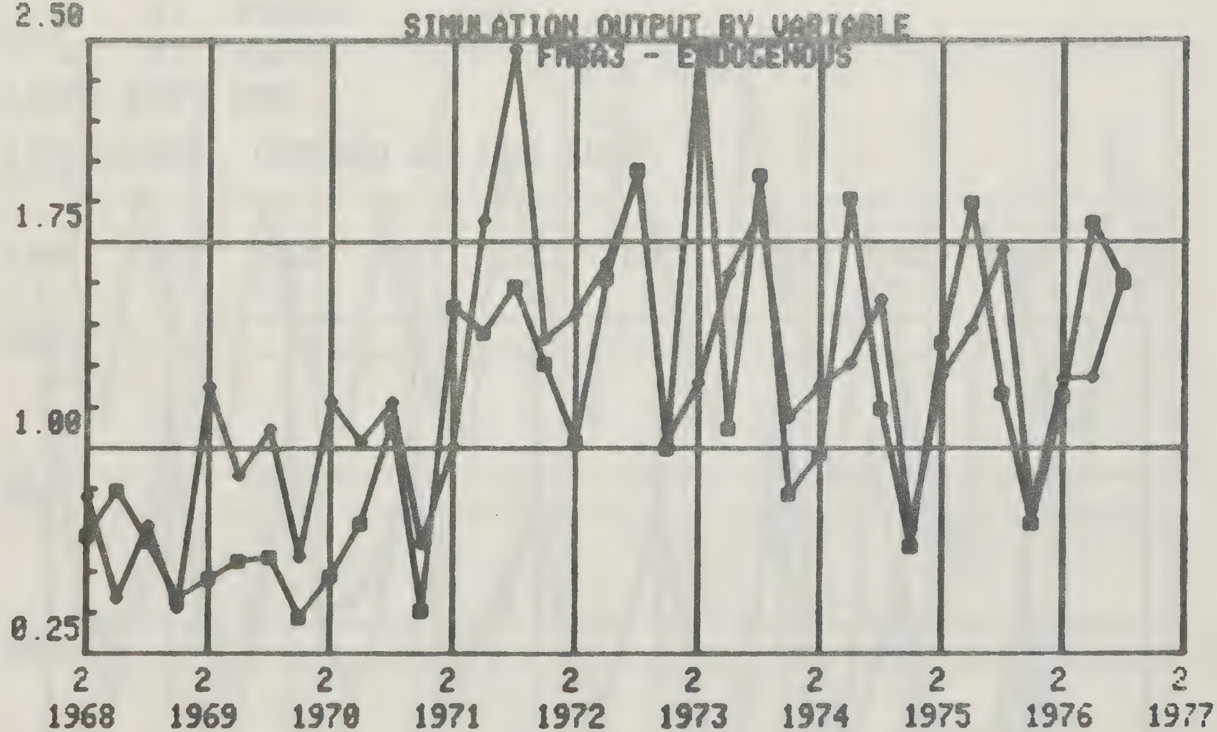


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
•	#1	GRNSIM1	DEMAND

FIGURE 6.12

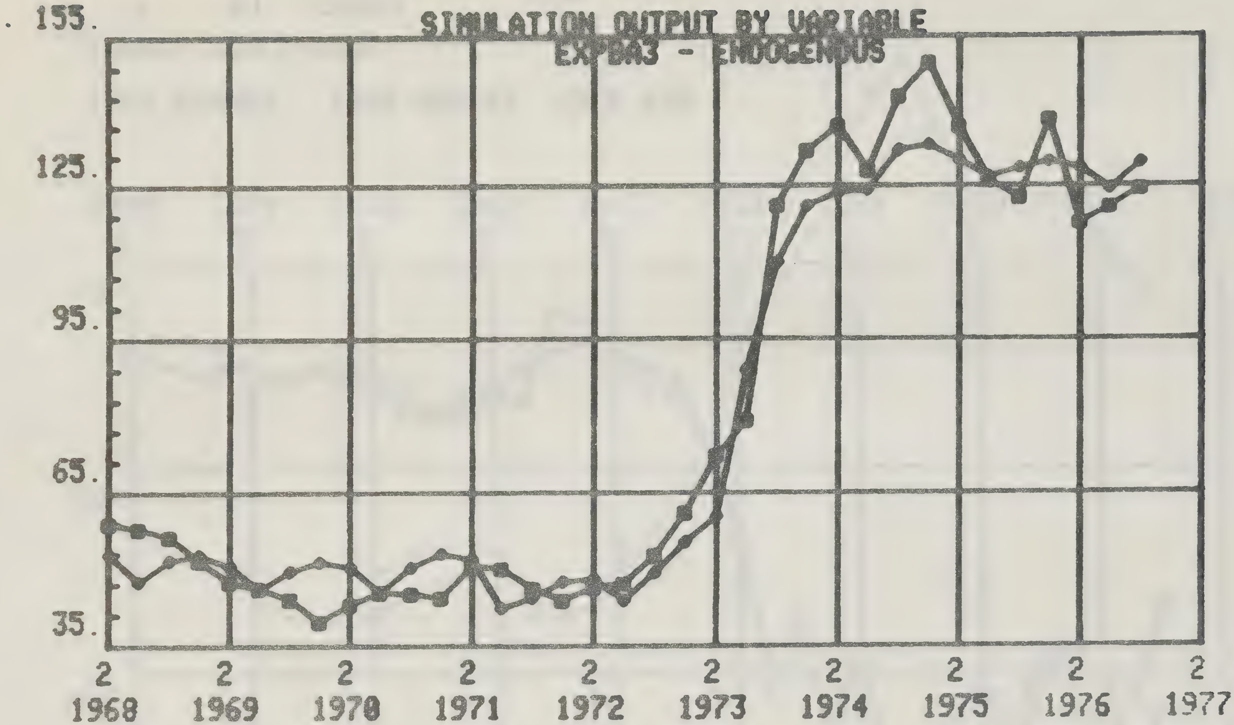
Canadian Farmer Marketings of Barley



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

Canadian Barley Export Price

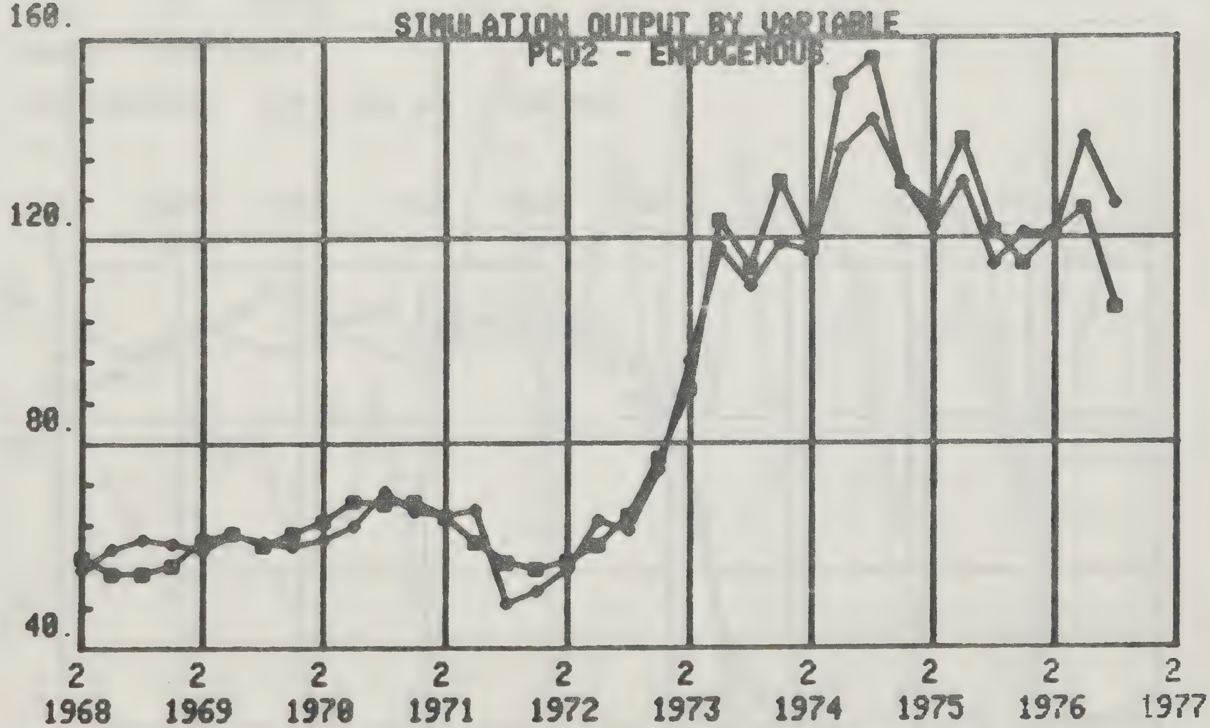


TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

FIGURE 6.14

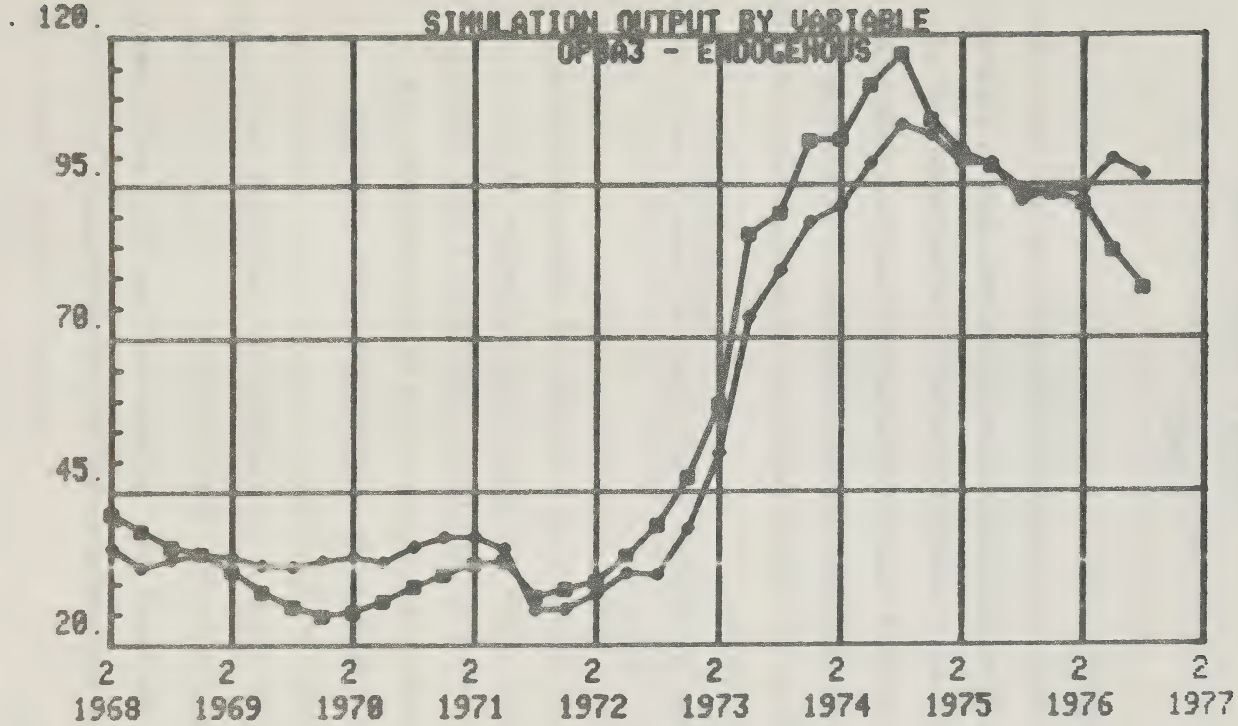
Canadian Wholesale Corn Price Montreal



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
●	#1	GRNSIM1	SIMULATED

Canadian Off-Board Barley Price



TIME BOUNDS: 1968 2ND TO 1976 4TH

SYMBOL	SCALE	NAME	
■	#1	GRAIN	ACTUAL
•	#1	GRNSIM1	SIMULATED

SECTION 7

Summary

7.0 CONCLUSIONS

This paper has presented an attempt to model the international wheat and feed grains sectors in a very simplistic manner on a quarterly basis. The preliminary results of this effort, albeit promising, show that additional work is required. However, the model does provide a capability for forecasting key economic variables, for evaluating government policies and for the examination of inter-sectoral relationships in Canadian agriculture.

Further developments in this aspect of research should continue in three areas of emphasis:

(a) development of more accurate and representative time-series data and more thorough information of the institutions involved in international grain markets;

(b) better specification of the existing structures and expansion and/or disaggregation of the components presented hitherto.

(c) application of more sophisticated econometric and simulation techniques and tests.

A discussion on point (a) above will now follow as (b) and (c) are more obvious improvements to the existing structure.

7.1 FUTURE WORK

In further development work in the specification and expansion of this model, one can categorize 2 areas of emphasis:

(1) Inventory Demand:

It is recognized that U.S. government policies towards grain stocks have a significant impact on world prices and hence grain markets (in particular feed grains). Consequently, further work in the area of analyzing decision rules by producers, grain trades and governments (Centrally Planned Economics included) to U.S. government policies would be fruitful in explaining movements in the levels of prices, stocks and exports (both supply and demand of exports). In addition, analysis of the behaviour of CWB stock holding policies would also render valuable insights into the workings of the Canadian grain marketing system.

(2) Import Demand:

Given the reliance of Canadian and U.S. grain markets on world developments, it is necessary to improve the structural representation incorporating the impacts of changes in world demand, supply and price policies in North American exports and prices. This may be done without further country disaggregation (disaggregation of U.S.S.R. from the ROW in the present model does not appear to improve forecasts) but inclusion of other exporting nations excess supply functions and corresponding import demand functions. Also, it may be useful to have a structure (simple and aggregate) explaining the relationship between importing nations prices and world (U.S.) prices and the resulting effect on Canadian and U.S. exports. Also, more work ought to be done in specifying annual world demand (income) and supply (production and beginning stocks) variables in quarterly excess demand and supply equations.

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There are many other areas of improvement for this model including improved formulation of expectations, formation patterns, risk formulations, endogenizing futures prices, endogenizing public policies explicitly, account for structural change and the like.

(3) World Price Numeraire:

The choice of numeraire for the world price variables is expected to be important in the flexible exchange rate regime and the related question of differential inflation rates. The S.D.R. was used here in an attempt to remove some of this bias but it may not be entirely satisfactory. This is because the S.D.R. tends to include stronger currencies which have appreciated against the U.S. dollar. Many important grain importing countries, however, have had weaker currencies which have depreciated in recent years.

TABLE 2.1

WHEAT AND FEED GRAIN PRODUCTION (000 tonnes)

	WHEAT				FEED GRAINS			
	Canada	U.S.A.	U.S.S.R.	ROW 1/	Canada	U.S.A.	U.S.S.R.	ROW
1967	16,137.6	41,030	77,419	162,500	12,346.6	162,911	58,392	318,600
1968	17,688.9	42,365	93,393	174,800	15,007.2	155,258	63,491	319,700
1969	18,267.6	39,263	79,917	172,200	15,825.1	161,682	68,621	331,400
1970	9,024.0	36,783	99,734	170,000	17,448	146,135	74,775	338,900
1971	14,412.0	44,029	98,760	192,100	22,208	189,673	70,605	347,100
1972	14,500	42,000	86,000	196,500	18,787	182,100	70,400	281,900
1973	16,500	46,400	109,800	196,100	18,400	186,700	96,500	302,300
1974	13,300	48,500	83,900	211,500	15,800	150,900	99,700	359,900
1975	17,100	57,800	66,200	209,100	18,155	185,100	65,800	373,700
1976	23,600	58,300	96,900	236,300	19,555	193,900	115,000	372,700
1977	19,900	55,400	92,200	214,000	20,705	203,600	92,600	276,200
1978	21,145.3	48,900	120,800	257,000	18,645	218,100	105,300	403,500
1979	17,185.0	58,300	90,100	254,200	16,926	234,500	80,000	394,000
1980	18,639.0 p	64,300			19,931 p			

1/ Refers to the rest of the world, excluding Canada, U.S. and U.S.S.R.

2/ Total feedgrain - mixed grains

TABLE 2.2

GRAIN DISPOSITION

(000 MT)

	WHEAT				FEED GRAINS			
	Food		Feed		Food		Feed	
	Canada	U.S. 1/	Canada	U.S. 1/	Canada	U.S. 2/ 3/	Canada	U.S. 2/
1967	1,645.5	14,130	1,461.1	1,554	83.4	14,200	8,650.7	114,400
1968	1,670.9	14,144	1,747.1	4,706	74.1	14,500	8,701.3	120,700
1969	1,758.8	14,168	2,307.9	5,819	76.2	14,900	9,976.9	128,700
1970	1,751.6	14,136	2,155.6	5,598	77.7	14,800	10,648.6	126,000
1971	1,760.9	14,261	2,230.2	7,076	80.0	15,150	11,750.4	90,744
1972	1,754.3	14,342	2,106.7	5,634	64.4	15,426	11,276.6	141,742
1973	1,821.5	14,424	1,925.4	3,647	76.3	9,700	11,137.4	138,200
1974	1,921.4	14,179	1,594.2	1,960	88.3	10,100	9,026.2	104,500
1975	1,894.2	15,213	1,802.0	2,204	89.7	11,000	9,411.1	115,300
1976	1,831.9	16,003	2,031.4	1,862	90.1	11,500	9,302.3	112,600
1977	1,955.0	15,952	2,081.6	4,989	90.3	12,500	9,810.1	117,300
1978	1,923.3	16,106	2,361.0	4,855	91.4	13,200	9,632.1	133,100
1979	1,924.0	16,201	2,612.2	2,561	96.2	14,100	9,632.3	135.900
1980								

1/ Source: Wheat Situation, U.S.D.A.

2/ Source: Feed Situation, U.S.D.A.

TABLE 2.3

TOTAL GRAIN INVENTORY LEVELS (END)

	August-July CANADA (Barley & Cuts)		U.S.A.		U.S.S.R.		ROW	
	Wheat	Feed Grains	Wheat	Feed Grains	Wheat	Feed Grains	Wheat	Feed Grains
1967	18,302.6	5,793.9	14,657	44,440		-2,000		
1968	23,182.8	8,873.3	22,226	45,966		+3,000		
1969	27,451.8	9,619.4	24,082	44,632		-20,000		
1970	19,981.1	7,338.4	19,894	30,699		-8,000		
1971	15,886.6	5,651.3	23,487	45,029		2,000	34,500	26,000
1972	9,944.9	5,430.1	11,920	30,202	2,000	0	28,700	21,900
1973	10,088.4	5,730.5	6,722	20,389	13,000	1,000	52,300	30,100
1974	8,037.6	5,236.5	11,800	15,500	-11,000	2,000	39,000	30,760
1975	7,979.7	3,994.0	18,100	17,300	-11,000	-3,000	37,000	35,700
1976	13,319.5	4,545.7	30,300	30,000	8,000	3,000	55,800	42,300
1977	12,115.2	6,882.0	32,300	41,200	-9,000	-5,000	39,700	35,900
1978	14,910.7	6,415.0	25,200	46,100	18,000	1,000	61,600	36,700
1979	10,610.1	2,881.0 f	24,600	52,300	-14,000	-2,000	44,500	32,300
1980								

TABLE 2.4

CANADA AND U.S. GRAIN EXPORTS

	WHEAT		FEED GRAINS	
	Canada	U.S.	Canada	U.S.
1967	9,145	20,714	956.2	20,571
1968	8,324	14,808	616.9	16,336
1969	9,430	16,492	2,002.5	19,066
1970	11,846	20,085	4,116.4	18,653
1971	13,710.2	17,200	5,181.0	24,387
1972	15,692.4	31,800	3,704.7	35,400
1973	11,413.6	31,100	2,788.4	43,800
1974	10,739.0	28,000	3,034.9	34,400
1975	12,284.5	31,500	4,621.5	46,300
1976	13,409.4	25,800	4,641	50,600
1977	15,998.3	31,100	4,274	52,100
1978	13,048.6	32,500	4,226	60,200
1979	15,904.9	24,500	5,042	70,600
1980				

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APPENDIX

EQUATION SPECIFICATION AND ESTIMATES
OF THE QUARTERLY FORECASTING MODEL FOR
THE INTERNATIONAL WHEAT AND FEED GRAINS SECTORS

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MODEL: GRAIN


SYMBOL DECLARATIONS


ENDOGENOUS:
   CIBA3    - COMMERCIAL INVENTORIES OF BARLEY, CANADA (M. TONNES)
   CIOA3    - COMMERCIAL INVENTORIES OF OATS, CANADA (M. TONNES)
   CIWH3    - COMMERCIAL INVENTORIES OF WHEAT, CANADA (M. TONNES)
   DDBA3    - FOOD INDUSTRY DEMAND FOR BARLEY, CANADA (M. TONNES)
   DDFG4    - FOOD INDUSTRY DEMAND FOR FEEDGRAINS, U.S.  (M. TONNES)
   DDOA3    - FOOD INDUSTRY DEMAND FOR OATS, CANADA (M. TONNES)
   DDWH3    - FOOD INDUSTRY DEMAND FOR WHEAT, CANADA (M. TONNES)
   DDWH4    - FOOD INDUSTRY DEMAND FOR WHEAT, U.S. (M. TONNES)
   DFFBA3   - FEED USE OF BARLEY ON FARMS, CANADA (M. TONNES)
   DFFG4.   - FEED DEMAND FOR FEEDGRAINS, U.S. (M. TONNES)
   DFFOA3   - FEED USE OF OATS ON FARMS, CANADA (M. TONNES)
   DFFWH3   - DEMAND FOR FEEDWHEAT ON FARMS, CANADA (M. TONNES)
   DFWH4    - FEED DEMAND FOR WHEAT, U.S. (M. TONNES)
   DISPWH   - TOTAL CANADA AND US WHEAT EXPORTS
   EXPBA3   - EXPORT PRICE OF CANADIAN BARLEY ($/TONNE)
   EXPOA3   - EXPORT PRICE OF CANADIAN OATS ($/TONNE)
   EXPWH3   - EXPORT PRICE OF CANADIAN WHEAT ($/TONNE)
   EXPWH4   - EXPORT PRICE OF U.S. WHEAT, GULF PORTS ($/TONNE)
   EX8FG4   - TOTAL US FEEDGRAIN EXPORTS
   FIBA3    - CLOSING FARM INVENTORIES OF BARLEY, CANADA (M. TONNES)
   FIOA3    - CLOSING FARM INVENTORIES OF OATS, CANADA (M. TONNES)
   FIWH3    - CLOSING FARM INVENTORIES OF WHEAT, CANADA (M. TONNES)
   FMBA3    - FARM MARKETINGS OF BARLEY, CANADA (M. TONNES)
   FMOA3    - FARM MARKETINGS OF OATS, CANADA (M. TONNES)
   FMWH3    - FARM MARKETINGS WHEAT, CANADA (M. TONNES)
   FPCO2    - PRICE OF CORN, CHATHAM ($/TONNE)
   IFG4     - CLOSING INVENTORIES OF FEEDGRAINS, U.S. (M. TONNES)
   IMPBA3   - IMPORT PRICE OF CANADIAN BARLEY FOB (SDR/TONNE)
   IMPCO4   - IMPORT PRICE U.S. CORN, CHICAGO (SDR/TONNE)
   IMPWH3   - IMPORT PRICE CANADIAN WHEAT, UNIT FOB (SDR/TONNE)
   IMPWH4   - IMPORT PRICE U.S. WHEAT, GULF PORTS 1HRW (SDR/TONNE)
   IM5FG3   - IMPORT DEMAND FOR CANADIAN FEEDGRAIN BY U.S.S.R. (M. TONNES)
   IM5WH3   - IMPORTS OF WHEAT BY U.S.S.R. FROM CANADA (M. TONNES)
   IM5WH4   - IMPORTS OF U.S. WHEAT BY U.S.S.R. (M. TONNES)
   IM7FG3   - IMPORTS OF CANADIAN FEEDGRAIN BY R.O.W. EXCL USSR (M. TONNES)
   IM7WH3   - IMPORTS OF CANADIAN WHEAT BY R.O.W. (M. TONNES)
   IM7WH4   - IMPORTS OF U.S. WHEAT BY R.O.W. (M. TONNES)
   IWH4     - US TOTAL ENDING WHEAT STOCKS
   OFBA3    - OFF-BOARD PRICE OF BARLEY, CANADA ($/TONNE)
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OFWH3	- OFF-BOARD PRICE OF WHEAT, CANADA ($/TONNE)
PBA2	- PRICE OF BARLEY, MONTREAL ($/TONNE)
PCO2	- PRICE OF U.S. CORN IN MONTREAL ($/TONNE)
PCO4	- PRICE OF CORN, CHICAGO (US$/TONNE)
POA2	- PRICE OF OATS, MONTREAL ($/TONNE)
PWH2	- PRICE OF FEEDWHEAT, MONTREAL ($/TONNE)
TSTK	- TOTAL ENDING CANADA AND US WHEAT STOCKS
XIPBA1	- INITIAL PRICE 2CW 6R.O.W. BARLEY, THUNDER BAY ($/TONNE)
XIPOA1	- INITIAL PRICE 2CW OATS, THUNDER BAY ($/TONNE)
XIPWH1	- INITIAL PRICE 1CWRS WHEAT, THUNDER BAY ($/TONNE)
XPBA1	- TOTAL CWB POOL PRICE 2CW 6R.O.W. BARLEY, THUNDER BAY ($/TONNE)
XPOA1	- TOTAL CWB POOL PRICE 2CW OATS, THUNDER BAY ($/TONNE)
XPWH1	- TOTAL CWB POOL PRICE 1CWRS WHEAT, THUNDER BAY ($/TONNE)

EXOGENOUS:

DCWB	- DUMMY FOR CHANGE IN CANADIAN GRAIN MARKETING REGULATIONS
DDS3	- DAYS LOST IN CANADIAN LAKES STRIKES
DISCFG4	- DISCREPANCY VARIABLE
DISCWH4	- DISCREPANCY VARIABLE
DSBA3	- SEED USE OF BARLEY, CANADA (M. TONNES)
DSFG4	- SEED USE FEEDGRAINS US
DSOA3	- SEED USE OF OATS, CANADA (M. TONNES)
DSWH3	- SEED USE OF WHEAT, CANADA (M. TONNES)
DSWH4	- SEED USE WHEAT US
DXUSSR	- DUMMY FOR CHANGE IN U.S.S.R. LIVESTOCK POLICY
DY4	- DISPOSABLE INCOME, U.S. (US$BILLIONS)
DY98	- INCOME ROW
EP1CO3	- FUTURES PRICE OF U.S. CORN ($CAN/TONNE)
EP1CO4	- FUTURES PRICE OF CORN, U.S. (US$/TONNE)
EP1WH3	- FUTURES PRICE CHICAGO WHEAT ONE QUARTER ($CAN/TONNE)
EP1WH4	- NEAR FUTURES PRICE WHEAT CHICAGO
ER3	- CDN $/SDR
ER34	- CDN/US $
ER4	- US $/SDR
EXBA3	- EXPORTS OF BARLEY, CANADA (M. TONNES)
EXOA3	- EXPORTS OF OATS, CANADA (M. TONNES)
EXWH3	- EXPORTS OF WHEAT, CANADA (M. TONNES)
FPLS3	- INDEX FARM PRICE LIVESTOCK, CANADA
FPLS4	- LIVESTOCK PRICE INDEX US
IAG5	- BEGINNING STOCKS OF ALL GRAINS USSR
IFG8	- INVENTORIES OF FEEDGRAIN, R.O.W. EXCL N. AMERICA (M. TONNES)
ILS5	- INDEX LIVESTOCK NUMBERS IN U.S.S.R. (BASE 1960(4)=1.0)

IMPSM4	-	IMPORT PRICE OF U.S. SOYMEAL (SDR/TONNE)
JS1	-	SEASONAL DUMMY, FIRST QUARTER
JS2	-	SEASONAL DUMMY, SECOND QUARTER
JS3	-	SEASONAL DUMMY, THIRD QUARTER
LNWH4	-	WHEAT LOAN RATE US
LRCO4	-	LOAN RATE CORN US
NELU4	-	LIVESTOCK PRODUCTION US
NPLU3	-	INDEX OF LIVESTOCK PROTEIN CONSUMING UNITS, CANADA (19 =)
NPLU4	-	LIVESTOCK PRODUCTION US
PCDY3	-	PER CAPITA DISPOSABLE INCOME, CANADA ($/CAPITA)
POPN3	-	POPULATION, CANADA (MILLIONS)
PSM4	-	PRICE SOYMEAL, DECATUR (US$/TONNE)
QBA3	-	PRODUCTION OF BARLEY, CANADA (M. TONNES)
QCO3	-	PRODUCTION OF CORN, CANADA (M. TONNES)
QFG4	-	PRODUCTION OF FEEDGRAINS, U.S. (M. TONNES)
QFG5	-	PRODUCTION OF FEEDGRAINS, U.S.S.R. (M. TONNES)
QFG8	-	ROW FEEDGRAIN PRODUCTION
QOA3	-	PRODUCTION OF OATS, CANADA (M. TONNES)
QWH3	-	PRODUCTION OF WHEAT, CANADA (M. TONNES)
QWH4	-	WHEAT PRODUCTION US
QWH5	-	USSR WHEAT PRODUCTION
QWH8	-	PRODUCTION OF WHEAT, R.O.W. EXCL CANADA, U.S. AND USSR (M. TONNES)
TIME	-	TIME TREND
T12	-	TRANSPORTATION COST GRAIN THUNDER BAY TO POINT EAST ($/TONNE)
USINT	-	SHORT TERM INTEREST RATE, U.S. (PERCENT)
XTWRA1	-	CHANGE IN TWRA PAYMENTS

COEFFICIENT:

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CIBA3.0  CIBA3.1  CIBA3.2  CIBA3.3  CIBA3.4  CIBA3.5  CIBA3.6  CIBA3.7  CIBA3.8  CIBA3.9  CIOA3.0  CIOA3.1  CIOA3.10
CIOA3.2  CIOA3.3  CIOA3.4  CIOA3.5  CIOA3.6  CIOA3.7  CIOA3.8  CIWH3.0  CIWH3.1  CIWH3.2  CIWH3.3  CIWH3.4  CIWH3.5
CIWH3.6  CIWH3.7  CIWH3.8  CIWH3.9  DDBA3.0  DDBA3.1  DDBA3.2  DDBA3.3  DDBA3.4  DDBA3.5  DDBA3.6  DDBA3.7  DDFG4.0
DDFG4.1  DDFG4.2  DDFG4.3  DDFG4.4  DDFG4.5  DDOA3.0  DDOA3.1  DDOA3.2  DDOA3.3  DDOA3.4  DDOA3.5  DDOA3.6  DDOA3.7
DDWH3.0  DDWH3.1  DDWH3.2  DDWH3.3  DDWH3.4  DDWH3.5  DDWH3.6  DDWH3.7  DDWH4.0  DDWH4.1  DDWH4.2  DDWH4.3  DDWH4.4
DDWH4.5  DFFG4.0  DFFG4.1  DFFG4.2  DFFG4.3  DFFG4.4  DFFG4.5  DFFG4.6  DFFG4.7  DFFG4.8  DFFG4.9  DFFWH3.A
DFFWH3.0  DFFWH3.1  DFFWH3.2  DFFWH3.3  DFFWH3.4  DFFWH3.6  DFFWH3.8  DFFWH3.9  EXPBA3.0  EXPBA3.1  EXPBA3.2
EXPBA3.3  EXPBA3.4  EXPBA3.5  EXPBA3.6  EXPBA3.7  EXPBA3.8  EXPBA3.9  EXPOA3.0  EXPOA3.1  EXPOA3.2  EXPOA3.3
EXPOA3.4  EXPOA3.5  EXPOA3.6  EXPOA3.7  EXPOA3.8  EXPOA3.9  EXPWH3.0  EXPWH3.1  EXPWH3.2  EXPWH3.3  EXPWH3.4
EXPWH3.5  EXPWH3.6  EXPWH3.7  EXPWH3.8  EXPWH3.9  EXPW3.10  FIBA3.0  FIBA3.1  FIBA3.2  FIBA3.3  FIBA3.4  FIBA3.5
FIBA3.6  FIBA3.7  FIBA3.8  FIBA3.9  FIOA3.0  FIOA3.1  FIOA3.2  FIOA3.3  FIOA3.4  FIOA3.5  FIOA3.6  FIOA3.7  FIOA3.8
FIOA3.9  FIWH3.0  FIWH3.1  FIWH3.2  FIWH3.3  FIWH3.4  FIWH3.5  FIWH3.6  FIWH3.7  FIWH3.8  FIWH3.9  FPC02.0  FPC02.1
FPC02.2  FPC02.3  FPC02.4  FPC02.5  FPC02.6  FPC02.7  IFG4.0  IFG4.1  IFG4.2  IFG4.3  IFG4.4  IFG4.5  IFG4.6  IFG4.7
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IMPCO4.D   IMPCO4.E   IMPCO4.F   IMPCO4.G   IMPWH3.0   IMPWH3.1   IMPWH3.2   IMPWH3.3   IMPWH3.4   IMPWH3.5   IMPWH3.6
IMPWH4.A   IMPWH4.B   IMPWH4.C   IMPWH4.D   IMPWH4.E   IMPWH4.F   IMPWH4.G   IMPWH4.0   IMPWH4.1   IMPWH4.2   IMPWH4.3
IMPWH4.4   IMPWH4.5   IMPWH4.6   IM5FG3.0   IM5FG3.1   IM5FG3.2   IM5FG3.3   IM5FG3.4   IM5FG3.5   IM5FG3.6
IM5FG3.7   IM5FG3.8   IM5FG3.9   IM5WH3.B   IM5WH3.0   IM5WH3.1   IM5WH3.2   IM5WH3.3   IM5WH3.4   IM5WH3.5   IM5WH3.6
IM5WH3.7   IM5WH3.8   IM5WH3.9   IM5WH4.B   IM5WH4.0   IM5WH4.1   IM5WH4.2   IM5WH4.3   IM5WH4.4   IM5WH4.5   IM5WH4.6
IM5WH4.7   IM5WH4.8   IM5WH4.9   IM7FG3.A   IM7FG3.B   IM7FG3.0   IM7FG3.1   IM7FG3.2   IM7FG3.3   IM7FG3.4   IM7FG3.5
IM7FG3.6   IM7FG3.7   IM7FG3.8   IM7FG3.9   IM7FG4.A   IM7FG4.B   IM7FG4.0   IM7FG4.1   IM7FG4.2   IM7FG4.3   IM7FG4.4
IM7FG4.6   IM7FG4.7   IM7FG4.8   IM7FG4.9   IM7WH3.A   IM7WH3.B   IM7WH3.0   IM7WH3.1   IM7WH3.2   IM7WH3.3   IM7WH3.4
IM7WH3.5   IM7WH3.6   IM7WH3.8   IM7WH3.9   IM7WH4.A   IM7WH4.B   IM7WH4.0   IM7WH4.1   IM7WH4.2   IM7WH4.3   IM7WH4.4
IM7WH4.5   IM7WH4.6   IM7WH4.8   IM7WH4.9   IWH4.0   IWH4.1   IWH4.2   IWH4.3   IWH4.4   IWH4.5   IWH4.6   IWH4.7   IWH4.8
IWH4.9   OFBA3.P   OFBA3.Q   OFBA3.R   OFBA3.S   OFBA3.T   OFBA3.U   OFBA3.V   OFBA3.W   OFBA3.X   OFBA3.0   OFBA3.1   OFBA3.2
OFBA3.3   OFBA3.4   OFBA3.5   OFBA3.7   OFBA3.8   OFBA3.9   OFOA3.A   OFOA3.L   OFOA3.P   OFOA3.Q   OFOA3.R   OFOA3.S   OFOA3.T
OFOA3.U   OFOA3.V   OFOA3.W   OFOA3.0   OFOA3.1   OFOA3.2   OFOA3.3   OFOA3.4   OFOA3.6   OFOA3.7   OFOA3.8   OFOA3.9   OFWH3.0
OFWH3.1   OFWH3.2   OFWH3.3   OFWH3.4   OFWH3.5   OFWH3.6   OFWH3.7   OFWH3.8   FBA2.0   FBA2.1   FBA2.2   FBA2.3   FBA2.4
FBA2.5   FBA2.6   FBA2.7   FBA2.8   FBA2.9   FCO2.0   FCO2.1   FCO2.2   FCO2.3   FCO2.4   FCO2.5   FCO2.6   FCO2.7   FOA2.0
FOA2.1   FOA2.2   FOA2.3   FOA2.4   FOA2.5   FOA2.6   FOA2.7   FOA2.8   FOA2.9   FWH2.0   FWH2.1   FWH2.2   FWH2.3   FWH2.4
FWH2.5   FWH2.6   FWH2.7   FWH2.8   FWH2.9   XIFBA1.0   XIFBA1.1   XIFBA1.2   XIFBA1.3   XIFOA1.0   XIFOA1.1   XIFOA1.2
XIFWH1.0   XIFWH1.1   XIFWH1.2   XIFWH1.3   XFBA1.0   XFBA1.1   XFBA1.2   XFBA1.3   XFBA1.4   XFBA1.5   XFBA1.6   XFOA1.0
XFOA1.1   XFOA1.2   XFOA1.3   XFOA1.4   XFOA1.5   XFOA1.6   XFWH1.0   XFWH1.1   XFWH1.2   XFWH1.3   XFWH1.4   XFWH1.5   XFWH1.6
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EQUATIONS

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    EXPORT PRICE US WHEAT:
52         EXPWH4 = IMPWH4.0+IMPWH4.1*TSTK+IMPWH4.2*TSTK*JS1+IMPWH4.3*TSTK*JS2+IMPWH4.4*TSTK*JS3+IMPWH4.5*(DISPWH+
           DISPWH(-1)+DISPWH(-2))+IMPWH4.6*EXPWH4(-1)

    IMPORT PRICE CANADIAN WHEAT:
33         IMPWH3 = IMPWH3.0+IMPWH3.1*JS1+IMPWH3.2*JS2+IMPWH3.3*JS3+IMPWH3.4*EXPWH3+IMPWH3.5*TIME+IMPWH3.6*ER3

    IMPORT PRICE CANADIAN BARLEY:
32         IMPBA3 = IMPBA3.0+IMPBA3.1*JS1+IMPBA3.2*JS2+IMPBA3.3*JS3+IMPBA3.4*EXPBA3+IMPBA3.5*ER3+IMPBA3.6*TIME

    OFF-BOARD PRICE WHEAT,CANADA:
43         OFWH3 = OFWH3.0+OFWH3.1*JS1+OFWH3.2*JS2+OFWH3.3*JS3+OFWH3.4*EXPWH3+OFWH3.5*DCWB+OFWH3.6*FIWH3(-1)+OFWH3.7
           *OFWH3(-1)+OFWH3.8*FWH2

    IMPORT DEMAND CANADIAN WHEAT BY USSR:
27         IM5WH3 = IM5WH3.0+IM5WH3.1*JS1+IM5WH3.2*JS2+IM5WH3.3*JS3+IM5WH3.4*IMPWH3+IM5WH3.5*IMPWH4+IM5WH3.6*DXUSSR+
           IM5WH3.7*QWH5+IM5WH3.8*IAG5+IM5WH3.9*TIME+IM5WH3.B*IM5WH3(-1)
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   IMPORT DEMAND US WHEAT BY USSR:
28      IM5WH4 = IM5WH4.0+IM5WH4.1*JS1+IM5WH4.2*JS2+IM5WH4.3*JS3+IM5WH4.4*IMPWH4+IM5WH4.5*IMPWH3+IM5WH4.6*QWH5+
        IM5WH4.7*DXUSSR+IM5WH4.8*IAG5+IM5WH4.9*TIME+IM5WH4.B*IM5WH4(-1)

   IMPORT DEMAND FOR CANADIAN WHEAT BY ROW                  :
23      IM7WH3 = IM7WH3.0+IM7WH3.1*JS1+IM7WH3.2*JS2+IM7WH3.3*JS3+IM7WH3.4*QWH8(-1)+IM7WH3.5*IMPWH4+IM7WH3.6*
        IMPWH3+IM7WH3.8*(EP1WH3-EXPWH3)+IM7WH3.9*TIME+IM7WH3.A*IM7WH3(-1)+IM7WH3.B*IM7WH4

   IMPORT DEMAND FOR US WHEAT BY ROW                        :
25      IM7WH4 = IM7WH4.0+IM7WH4.1*JS1+IM7WH4.2*JS2+IM7WH4.3*JS3+IM7WH4.4*IMPWH4+IM7WH4.5*IMPSM4+IM7WH4.6*(EP1WH4
        -EXPWH4)+IM7WH4.8*IM7WH4(-1)+IM7WH4.9*TIME+IM7WH4.A*IM7WH3+IM7WH4.B*QWH8(-3)

   IMPORT DEMAND FOR CANADIAN FEEDGRAIN BY USSR             :
26      IM5FG3 = IM5FG3.0+IM5FG3.1*JS1+IM5FG3.2*JS2+IM5FG3.3*JS3+IM5FG3.4*QFG5+IM5FG3.5*IMPBA3+IM5FG3.6*IAG5+
        IM5FG3.7*IMPCO4+IM5FG3.8*DXUSSR+IM5FG3.9*ILS5+IM5FG3.A*IM5FG3(-1)

   IMPORT DEMAND FOR CANADIAN FEEDGRAIN BY ROW              :
22      IM7FG3 = IM7FG3.0+IM7FG3.1*JS1+IM7FG3.2*JS2+IM7FG3.3*JS3+IM7FG3.4*IMPCO4+IM7FG3.5*IMPBA3+IM7FG3.6*TIME+
        IM7FG3.7*(EP1CO4-PCO4)+IM7FG3.8*IMPSM4+IM7FG3.9*QFG8+IM7FG3.A*IFG8+IM7FG3.B*IM7FG3(-1)

   IMPORT DEMAND FOR US FEEDGRAIN BY ROW                    :
24      EX8FG4 = IM7FG4.0+IM7FG4.1*JS1+IM7FG4.2*JS2+IM7FG4.3*JS3+IM7FG4.4*PCO4+IM7FG4.6*EXPWH4+IM7FG4.9*PSM4+
        IM7FG4.A*IFG8+IM7FG4.7*ER4+IM7FG4.8*EP1CO4+IM7FG4.B*DY98

   CLOSING COMMERCIAL INVENTORIES WHEAT, CANADA:
19      CIWH3 = CIWH3.0+CIWH3.1*JS1+CIWH3.2*JS2+CIWH3.3*JS3+CIWH3.4*EXPWH3+CIWH3.5*(EP1WH3-EXPWH3)+CIWH3.6*DDS3+
        CIWH3.7*CIWH3(-1)+CIWH3.8*XTWRA1+CIWH3.9*(FIWH3(-1)+QWH3)

   CLOSING INVENTORIES TOTAL FEEDGRAINS US:
20      IFG4 = IFG4.0+IFG4.1*JS1+IFG4.2*JS2+IFG4.3*JS3+IFG4.4*PCO4+IFG4.5*LRCO4+IFG4.6*QFG4+IFG4.7*EP1CO4+IFG4.8*
        USINT+IFG4.9*IFG4(-1)

   FOOD INDUSTRY DEMAND CANADIAN WHEAT                      :
8       DDWH3 = DDWH3.0+DDWH3.1*JS1+DDWH3.2*JS2+DDWH3.3*JS3+DDWH3.4*PCDY3+DDWH3.5*POPN3+DDWH3.6*EXPWH3+DDWH3.7*
        DDWH3(-1)

   FOOD INDUSTRY DEMAND US WHEAT                            :
10      DDWH4 = DDWH4.0+DDWH4.1*JS1+DDWH4.2*JS2+DDWH4.3*JS3+DDWH4.4*DY4+DDWH4.5*EXPWH4

   FOOD INDUSTRY DEMAND US FEEDGRAINS                       :
9       DDFG4 = DDFG4.0+DDFG4.1*JS1+DDFG4.2*JS2+DDFG4.3*JS3+DDFG4.4*DY4+DDFG4.5*PCO4

   FARM MARKETINGS WHEAT,CANADA                  :
13      FMWH3 = QWH3+FIWH3(-1)-DFFWH3-DSWH3-FIWH3

   FARM MARKETINGS OATS ,CANADA                  :
12      FMOA3 = QOA3+FIOA3(-1)-DFFOA3-DSOA3-FIOA3
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FARM MARKETINGS BARLEY,CANADA
11      FMBA3 = QBA3+FIBA3(-1)-DFFBA3-DSBA3-FIBA3

CLOSING FARM INVENTORIES CANADIAN WHEAT                    ;
16      FIWH3 = FIWH3.0+FIWH3.1*JS1+FIWH3.2*JS2+FIWH3.3*JS3+FIWH3.4*OFWH3+FIWH3.5*(EP1WH3-OFWH3)+FIWH3.6*FPLS3+
        FIWH3.7*FIWH3(-1)+FIWH3.8*QWH3+FIWH3.9*DCWB

CLOSING FARM INVENTORIES CANADIAN OATS                     ;
15      FIOA3 = FIOA3.0+FIOA3.1*JS1+FIOA3.2*JS2+FIOA3.3*JS3+FIOA3.4*OFOA3+FIOA3.5*FIOA3(-1)+FIOA3.6*QOA3+FIOA3.7*
        DCWB+FIOA3.8*(EP1CO3-PCO2)+FIOA3.9*FPLS3

CLOSING FARM INVENTORIES CANADIAN BARLEY                   ;
14      FIBA3 = FIBA3.0+FIBA3.1*JS1+FIBA3.2*JS2+FIBA3.3*JS3+FIBA3.4*OFBA3+FIBA3.5*FPLS3+FIBA3.6*FIBA3(-1)+FIBA3.7
        *QBA3+FIBA3.8*(EP1CO3-PCO2)+FIBA3.9*DCWB

FEED USE ON FARMS,CANADIAN WHEAT                           ;
3       DFFWH3 = DFFWH3.0+DFFWH3.1*JS1+DFFWH3.2*JS2+DFFWH3.3*JS3+DFFWH3.4*OFWH3+DFFWH3.6*FPLS3(-1)+DFFWH3.8*NPLU3
        +DFFWH3.9*DFFWH3(-1)+DFFWH3.A*DCWB

FEED USE ON FARMS CANADIAN OATS:
2       DFFOA3 = OFOA3.0+OFOA3.1*JS1+OFOA3.2*JS2+OFOA3.3*JS3+OFOA3.4*OFOA3+OFOA3.6*OFWH3+OFOA3.7*FPLS3(-1)+
        OFOA3.8*NPLU3+OFOA3.9*DCWB+OFOA3.A*DFFOA3(-1)

FEED USE ON FARMS CANADIAN BARLEY:
1       DFFBA3 = OFBA3.0+OFBA3.1*JS1+OFBA3.2*JS2+OFBA3.3*JS3+OFBA3.4*OFBA3+OFBA3.5*DFFBA3(-1)+OFBA3.7*NPLU3+
        OFBA3.8*FPLS3+OFBA3.9*DCWB

FEED USE, US FEEDGRAINS                                    ;
4       DFFG4 = DFFG4.0+DFFG4.1*JS1+DFFG4.2*JS2+DFFG4.3*JS3+DFFG4.4*PCO4+DFFG4.5*NELU4+DFFG4.8*PSM4+DFFG4.9*
        EXPWH4+DFFG4.6*NPLU4+DFFG4.7*FPLS4

EXPORT PRICE CANADIAN OATS                      ;
30      EXPOA3 = EXPOA3.0+EXPOA3.1*JS1+EXPOA3.2*JS2+EXPOA3.3*JS3+EXPOA3.4*POA2+EXPOA3.5*CIOA3(-1)+EXPOA3.6*FIOA3(
        -1)+EXPOA3.7*QOA3+EXPOA3.8*EXPOA3(-1)+EXPOA3.9*DCWB

EXPORT PRICE CANADIAN BARLEY                    ;
29      EXPBA3 = EXPBA3.0+EXPBA3.1*JS1+EXPBA3.2*JS2+EXPBA3.3*JS3+EXPBA3.4*PBA2+EXPBA3.5*CIBA3(-1)+EXPBA3.6*FIBA3(
        -1)+EXPBA3.7*DCWB+EXPBA3.8*QBA3+EXPBA3.9*EXPBA3(-1)

PRICE FEEDWHEAT,MONTREAL                        ;
37      PWH2 = PWH2.0+PWH2.1*JS1+PWH2.2*JS2+PWH2.3*JS3+PWH2.4*EXPWH4+PWH2.5*ER34+PWH2.6*CIWH3(-1)+PWH2.8*FIWH3(-1
        )+PWH2.7*DCWB+PWH2.9*PWH2(-1)
```

```
   PRICE OATS, MONTREAL
39      FOA2 = FOA2.0+FOA2.1*JS1+FOA2.2*JS2+FOA2.3*JS3+FOA2.4*FCO2+FOA2.5*T12+FOA2.6*FIOA3(-1)+FOA2.8*CIOA3(-1)+
        FOA2.7*FOA2(-1)+FOA2.9*DCWB

   PRICE BARLEY,MONTREAL
37      FBA2 = FBA2.0+FBA2.1*JS1+FBA2.2*JS2+FBA2.3*JS3+FBA2.4*FCO2+FBA2.5*T12+FBA2.6*FIBA3(-1)+FBA2.8*CIBA3(-1)+
        FBA2.7*DCWB+FBA2.9*FBA2(-1)

   PRICE OF CORN, CHATHAM:
40      FFCO2 = FFCO2.0+FFCO2.1*JS1+FFCO2.2*JS2+FFCO2.3*JS3+FFCO2.4*QCO3+FFCO2.5*FCO2+FFCO2.6*T12+FFCO2.7*FFCO2(
        -1)

   OFF-BOARD PRICE OATS,CANADA:
42      OFOA3 = OFOA3.P+OFOA3.Q*JS1+OFOA3.R*JS2+OFOA3.S*JS3+OFOA3.T*EXFOA3+OFOA3.U*FIOA3(-1)+OFOA3.V*DCWB+OFOA3.W
        *OFOA3(-1)+OFOA3.L*FOA2

   OFF-BOARD PRICE BARLEY,CANADA:
41      OFBA3 = OFBA3.P+OFBA3.Q*JS1+OFBA3.R*JS2+OFBA3.S*JS3+OFBA3.T*FBA2+OFBA3.U*FIBA3(-1)+OFBA3.V*DCWB+OFBA3.W*
        OFBA3(-1)+OFBA3.X*EXFBA3


   TOTAL CWB POOL PRICE 1WRS WHEAT:
49      XFWH1 = JS1*(XFWH1.0+XFWH1.1*EXFWH3(-3)+XFWH1.2*EXFWH3(-4)+XFWH1.3*EXFWH3(-5)+XFWH1.4*EXFWH3(-6)+XFWH1.5*
        EXWH3(-6)+XFWH1.6*TIME)

   TOTAL CWB POOL PRICE 2CW OATS
48      XFOA1 = JS1*(XFOA1.0+XFOA1.1*EXFOA3(-3)+XFOA1.2*EXFOA3(-4)+XFOA1.3*EXFOA3(-5)+XFOA1.4*EXFOA3(-6)+XFOA1.5*
        EXOA3(-6)+XFOA1.6*TIME)

   TOTAL CWB POOL PRICE 2CW GROW BARLEY
47      XFBA1 = JS1*(XFBA1.0+XFBA1.1*EXFBA3(-3)+XFBA1.2*EXFBA3(-4)+XFBA1.3*EXFBA3(-5)+XFBA1.4*EXFBA3(-6)+XFBA1.5*
        EXBA3(-6)+XFBA1.6*TIME)

   INITIAL PRICE 1CWRS WHEAT
46      XIFWH1 = XIFWH1.0+XIFWH1.1*XIFWH1(-1)+XIFWH1.2*(EXFWH3(-3)-XIFWH1(-1))+XIFWH1.3*XIFWH1(-4)

   INITIAL PRICE 2CW OATS
45      XIFOA1 = XIFOA1.0*XIFOA1(-1)+XIFOA1.1*(EXFOA3(-3)-XIFOA1(-1))+XIFOA1.2*XIFOA1(-4)

   INITIAL PRICE 2CW 6ROW BARLEY
44      XIFBA1 = XIFBA1.0+XIFBA1.1*XIFBA1(-1)+XIFBA1.2*(EXFBA3(-3)-XIFBA1(-1))+XIFBA1.3*XIFBA1(-4)
```

```
   CORN PRICE MONTREAL.
36     PCO2 = PCO2.0+PCO2.1*JS1+PCO2.2*JS2+PCO2.3*JS3+PCO2.4*PCO4+PCO2.5*T12+PCO2.6*ER34+PCO2.7*TIME

   EXPORT PRICE WHEAT CANADA:
31     EXPWH3 = EXPWH3.0+EXPWH3.1*JS1+EXPWH3.2*JS2+EXPWH3.3*JS3+EXPWH3.4*EXPWH4+EXPWH3.5*ER34+EXPWH3.6*CIWH3(-1)
       +EXPWH3.7*DCWB+EXPWH3.8*FIWH3(-1)+EXPWH3.9*QWH3+EXPW3.10*FXPWH3(-1)

   US TOTAL ENDING WHEAT STOCKS:
21     IWH4 = IWH4.0+IWH4.1*JS1+IWH4.2*JS2+IWH4.3*JS3+IWH4.4*EXPWH4+IWH4.5*LNWH4+IWH4.6*QWH4+IWH4.7*USINT+IWH4.8
       *(EP1WH4-EXPWH4)+IWH4.9*IWH4(-1)

   IMPORT PRICE WHEAT US:
35     IMPWH4 = IMPWH4.A+IMPWH4.B*JS1+IMPWH4.C*JS2+IMPWH4.D*JS3+IMPWH4.E*EXPWH4+IMPWH4.F*ER4+IMPWH4.G*TIME

   IMPORT PRICE CORN US:
34     IMPCO4 = IMPCO4.A+IMPCO4.B*JS1+IMPCO4.C*JS2+IMPCO4.D*JS3+IMPCO4.E*PCO4+IMPCO4.F*ER4+IMPCO4.G*TIME

   ENDING COMMERCIAL STOCKS OF OATS CANADA:
18     CIOA3 = CIOA3.0+CIOA3.1*JS1+CIOA3.2*JS2+CIOA3.3*JS3+CIOA3.4*EXPOA3+CIOA3.5*(EP1CO3-PCO2)+CIOA3.6*DDS3+
       CIOA3.7*XTWRA1+CIOA3.8*CIOA3(-1)+CIOA3.10*(FIOA3(-1)+QOA3)

   ENDING COMMERCIAL STOCKS OF BARLEY CANADA:
17     CIBA3 = CIBA3.0+CIBA3.1*JS1+CIBA3.2*JS2+CIBA3.3*JS3+CIBA3.4*EXPBA3+CIBA3.5*CIBA3(-1)+CIBA3.6*DDS3+CIBA3.7
       *(FIBA3(-1)+QBA3)+CIBA3.8*XTWRA1+CIBA3.9*(EP1CO3-PCO2)

   FOOD AND INDUSTRY BARLEY CANADA:
6      DDBA3 = DDBA3.0+DDBA3.1*JS1+DDBA3.2*JS2+DDBA3.3*JS3+DDBA3.4*EXPBA3+DDBA3.5*POPN3+DDBA3.6*PCDY3+DDBA3.7*
       DDBA3(-1)

   FOOD AND INDUSTRY OATS CANADA:
7      DDOA3 = DDOA3.0+DDOA3.1*JS1+DDOA3.2*JS2+DDOA3.3*JS3+DDOA3.4*EXPOA3+DDOA3.5*PCDY3+DDOA3.6*POPN3+DDOA3.7*
       DDOA3(-1)

   BALANCING IDENTITY FEEDGRAINS US:
53     QFG4+IFG4(-1)+IMFG4 = IFG4+EXBFG4+DDFG4+DFFG4+DSFG4+DISCFG4

   BALANCING IDENTITY WHEAT US:
5      QWH4+IWH4(-1) = IWH4+IM7WH4+IM5WH4+DDWH4+DFWH4+DSWH4+DISCWH4

   TOTAL  AVAILABILITY OF CANADA AND US WHEAT:
50     TSTK = FIWH3(-1)+CIWH3(-1)+IWH4(-1)+QWH3+QWH4

   TOTAL CANADA AND US WHEAT EXPORTS:
51     DISPWH = IM7WH3+IM7WH4+IM5WH3+IM5WH4
```

1 DFFBA3 = OPBA3.0+OPBA3.1*JS1+OPBA3.2*JS2+OPBA3.3*JS3+OPBA3.4*OPBA3+OPBA3.5*DFFBA3(-1)+OPBA3.7*NPLU3+OPBA3.8*FPLS3+OPBA3.9*DCWB

NOB = 37 NOVAR = 9
RANGE = 1967 4 TO 1976 4
RSQ = 0.94087 CRSQ = 0.92398 F(8/28) = 55.693
SER = 0.0699 SSR = 0.137 DW(0) = 1.26
LHS MEAN = 1.06588 SR = 0.00004

COEF	VALUE	ST ER	T-STAT	MEAN
OPBA3.0	-0.10387	0.38221	-0.27176	1.00000
OPBA3.1	-0.26021	0.04388	-5.92983	0.24324
OPBA3.2	-0.61069	0.06783	-9.00350	0.24324
OPBA3.3	-0.47319	0.06742	-7.01881	0.24324
OPBA3.4	-0.00133	0.00139	-0.95516	58.41620
OPBA3.5	0.91702	0.05981	15.33240	1.05138
OPBA3.7	0.00915	0.00690	1.32683	60.77510
OPBA3.8	0.04795	0.12889	0.37202	1.10941
OPBA3.9	0.00182	0.10229	0.01782	0.37838

2 DFFOA3 = OPOA3.0+OPOA3.1*JS1+OPOA3.2*JS2+OPOA3.3*JS3+OPOA3.4*OPOA3+OPOA3.6*OPWH3+OPOA3.7*FPLS3(-1)+OPOA3.8*NPLU3+OPOA3.9*DCWB+OPOA3.A*DFFOA3(-1)

NOB = 37 NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.95694 CRSQ = 0.94258 F(9/27) = 66.663
SER = 0.0514 SSR = 7.144E-02 DW(0) = 1.39
LHS MEAN = 1.01571 SR = 0.

COEF	VALUE	ST ER	T-STAT	MEAN
OPOA3.0	0.55375	0.30757	1.80042	1.00000
OPOA3.1	-0.18965	0.04902	-3.86864	0.24324
OPOA3.2	-0.52631	0.06540	-8.04820	0.24324
OPOA3.3	-0.45970	0.05550	-8.28245	0.24324
OPOA3.4	-0.00437	0.00229	-1.90502	53.96240
OPOA3.6	0.00181	0.00204	0.88949	70.35480
OPOA3.7	-0.07670	0.11175	-0.68631	1.09132
OPOA3.8	0.00319	0.00548	0.58134	60.77510
OPOA3.9	0.05839	0.08334	0.70063	0.37838
OPOA3.A	0.71532	0.10503	6.81072	1.01217

3 DFFWH3 = DFFWH3.0+DFFWH3.1*JS1+DFFWH3.2*JS2+DFFWH3.3*JS3+DFFWH3.4*OPWH3+DFFWH3.6*FPLS3(-1)+DFFWH3.8*NPLU3+DFFWH3.9*DFFWH3(-1)+DFFWH3.A*DCWB

NOB = 37 NOVAR = 9
RANGE = 1967 4 TO 1976 4
RSQ = 0.78627 CRSQ = 0.72521 F(8/28) = 12.876
SER = 0.0369 SSR = 3.808E-02 DW(0) = 1.23
LHS MEAN = 0.31414 SR = 0.00001

COEF	VALUE	ST ER	T-STAT	MEAN
DFFWH3.0	0.34936	0.20524	1.70225	1.00000
DFFWH3.1	-0.08832	0.02559	-3.45194	0.24324
DFFWH3.2	-0.10196	0.03880	-2.[illegible]	0.24324
DFFWH3.3	-0.06208	0.03950	-1.[illegible]027	0.24324
DFFWH3.4	-0.00208	7.39970E-04	-2.81464	70.35480
DFFWH3.6	0.19027	0.07294	2.60847	1.09132
DFFWH3.8	-0.00570	0.00400	-1.42348	60.77510
DFFWH3.9	0.92947	0.16221	5.73015	0.30560
DFFWH3.A	0.07250	0.06003	1.20786	0.37838

4 DFFG4 = DFFG4.0+DFFG4.1*JS1+DFFG4.2*JS2+DFFG4.3*JS3+DFFG4.4*PCO4+DFFG4.5*NELU4+DFFG4.8*PSM4+DFFG4.9*EXPWH4+DFFG4.6*NPLU4+DFFG4.7*FPLS4

NOB = 44 NOVAR = 10
RANGE = 1966 1 TO 1976 4
RSQ = 0.89807 CRSQ = 0.87109 F(9/34) = 33.286
SER = 2.6517 SSR = 239.074 DW(0) = 1.17
LHS MEAN = 31.21470 SR = 0.0027

COEF	VALUE	ST ER	T-STAT	MEAN
DFFG4.0	32.29210	19.10470	1.69026	1.00000
DFFG4.1	-4.68107	1.32239	-3.53985	0.25000
DFFG4.2	-10.63570	1.79481	-5.92580	0.25000
DFFG4.3	-14.73590	1.28174	-11.49680	0.25000
DFFG4.4	-0.24390	0.04745	-5.14051	71.88570
DFFG4.5	9.18253	7.33220	1.25236	18.71460
DFFG4.8	0.02538	0.01106	2.29462	124.22000
DFFG4.9	0.15844	0.03147	5.03477	94.42650
DFFG4.6	-0.24283	0.23741	-1.02280	630.32200
DFFG4.7	-0.44042	0.22610	-1.94788	29.36580

5 DFWH4 = DFWH4.0+DFWH4.1*JS1+DFWH4.2*JS2+DFWH4.3*JS3+DFWH4.4*EXPWH4+DFWH4.6*DFWH4(-4)+DFWH4.9*NELU4+DFWH4.8*FPLS4+
DFWH4.10*PSM4

NOB = 37 NOVAR = 9
RANGE = 1967 4 TO 1976 4
RSQ = 0.72042 CRSQ = 0.64054 F(8/28) = 9.019
SER = 0.8733 SSR = 21.356 DW(0) = 2.16

COEF	VALUE	ST ER	T-STAT
DFWH4.0	0.38857	3.56367	0.10904
DFWH4.1	0.51407	0.43543	1.18060
DFWH4.2	-0.31352	0.43291	-0.72422
DFWH4.3	1.51483	0.62543	2.42208
DFWH4.4	-0.00382	0.00630	-0.60551
DFWH4.6	0.39034	0.18985	2.05609
DFWH4.9	0.04315	0.20263	0.21295
DFWH4.8	-0.01423	0.04954	-0.28725
DFWH4.10	-0.00174	0.00362	-0.48090

6 DDBA3 = DDBA3.0+DDBA3.1*JS1+DDBA3.2*JS2+DDBA3.3*JS3+DDBA3.4*EXPBA3+DDBA3.5*POPN3+DDBA3.6*PCDY3+DDBA3.7*DDBA3(-1)

NOB = 37 NOVAR = 8
RANGE = 1967 4 TO 1976 4
RSQ = 0.60073 CRSQ = 0.50436 F(7/29) = 6.233
SER = 0.1243 SSR = 0.448 DW(0) = 2.07
LHS MEAN = 0.43085 SR = 0.

COEF	VALUE	ST ER	T-STAT	MEAN
DDBA3.0	0.37236	2.07903	0.17910	1.00000
DDBA3.1	-0.08443	0.06829	-1.23638	0.24324
DDBA3.2	0.14704	0.06051	2.42968	0.54324
DDBA3.3	-0.21262	0.09445	-2.25105	0.54324
DDBA3.4	5.90262E-04	0.00116	0.50838	79.92700
DDBA3.5	3.17862E-04	0.10636	0.00299	21.78660
DDBA3.6	5.93244E-05	3.46415E-04	0.17125	861.96400
DDBA3.7	-0.02396	0.18310	-0.13084	0.42844

7 DDOA3 = DDOA3.0+DDOA3.1*JS1+DDOA3.2*JS2+DDOA3.3*JS3+DDOA3.4*EXPOA3+DDOA3.5*PCDY3+DDOA3.6*POPN3+DDOA3.7*DDOA3(-1)

NOB = 37 NOVAR = 8
RANGE = 1967 4 TO 1976 4
RSQ = 0.44043 CRSQ = 0.30537 F(7/29) = 3.261
SER = 0.0687 SSR = 0.137 DW(0) = 2.12
LHS MEAN = 0.12964 SR = -0.00001

COEF	VALUE	ST ER	T-STAT	MEAN
DDOA3.0	-0.22153	1.33542	-0.16589	1.00000
DDOA3.1	0.00149	0.03748	0.03971	0.24324
DDOA3.2	-0.00165	0.03699	-0.04460	0.24324
DDOA3.3	-0.13279	0.04641	-2.86118	0.54324
DDOA3.4	-5.87047E-04	0.00105	-0.55779	71.91800
DDOA3.5	1.84646E-05	2.38689E-04	0.07736	861.96400
DDOA3.6	0.01786	0.06808	0.26239	21.78660
DDOA3.7	0.15707	0.16972	0.92550	0.13129

8 DDWH3 = DDWH3.0+DDWH3.1*JS1+DDWH3.2*JS2+DDWH3.3*JS3+DDWH3.4*PCDY3+DDWH3.5*POPN3+DDWH3.6*EXPWH3+DDWH3.7*DDWH3(-1)

NOB = 37 NOVAR = 8
RANGE = 1967 4 TO 1976 4
RSQ = 0.6586 CRSQ = 0.57619 F(7/29) = 7.992
SER = 0.4899 SSR = 6.960 DW(0) = 2.05
LHS MEAN = 0.49923 SR = -0.00006

COEF	VALUE	ST ER	T-STAT	MEAN
DDWH3.0	-30.68730	11.20510	-2.73869	1.00000
DDWH3.1	0.04109	0.23565	0.17436	0.24324
DDWH3.2	0.40084	0.22728	1.76362	0.24324
DDWH3.3	0.14471	0.29885	0.48421	0.24324
DDWH3.4	-0.00287	0.00150	-1.91201	861.96400
DDWH3.5	1.54268	0.56845	2.71385	21.78660
DDWH3.6	-0.00210	0.00281	-0.74523	108.65600
DDWH3.7	0.29981	0.17376	1.72548	0.46145

17 CIBA3 = CIBA3.0+CIBA3.1*JS1+CIBA3.2*JS2+CIBA3.3*JS3+CIBA3.4*EXPBA3+CIBA3.5*CIBA3(-1)+CIBA3.6*DDS3+CIBA3.7*(FIBA3(-1)+GBA3)+CIBA3.8*XTWRA1+CIBA3.9*(EP1CO3-PCO2)

```
NOB = 37       NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.77132     CRSQ =   0.69509     F(9/27) =      10.119
SER =    0.2434      SSR =    1.600       DW(0) =   2.25
LHS MEAN =      1.84464     SR =      0.00008
```

COEF	VALUE	ST ER	T-STAT	MEAN
CIBA3.0	-0.67978	0.76953	-0.88336	1.00000
CIBA3.1	0.25441	0.16201	1.57035	0.24324
CIBA3.2	0.22148	0.22231	0.99628	0.24324
CIBA3.3	-0.31153	0.16025	-1.94400	0.24324
CIBA3.4	0.00463	0.00540	0.85723	79.92700
CIBA3.5	0.43597	0.13990	3.11634	1.83379
CIBA3.6	2.27638E-06	1.09842E-06	2.07242	16366.10000
CIBA3.7	0.11291	0.03746	3.01434	8.78601
CIBA3.8	0.15425	0.38810	0.39744	-0.64865
CIBA3.9	-0.01664	0.01335	-1.24621	-11.15960

18 CIOA3 = CIOA3.0+CIOA3.1*JS1+CIOA3.2*JS2+CIOA3.3*JS3+CIOA3.4*EXPOA3+CIOA3.5*(EP1CO3-PCO2)+CIOA3.6*DDS3+CIOA3.7*XTWRA1+CIOA3.8*CIOA3(-1)+CIOA3.10*(FIOA3(-1)+GOA3)

```
NOB = 37       NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.54007     CRSQ =   0.38676     F(9/27) =      3.523
SER =    0.0668      SSR =    0.120       DW(0) =   1.81
LHS MEAN =      0.34160     SR =      0.
```

COEF	VALUE	ST ER	T-STAT	MEAN
CIOA3.0	0.15810	0.24368	0.64882	1.00000
CIOA3.1	0.02240	0.04917	0.45561	0.24324
CIOA3.2	0.01684	0.08129	0.20720	0.24324
CIOA3.3	0.06815	0.04927	1.38309	0.24324
CIOA3.4	-5.19648E-04	0.00120	-0.43221	71.91890
CIOA3.5	0.00260	0.00351	0.74075	-11.15960
CIOA3.6	-1.12509E-07	2.84867E-07	-0.39495	16366.10000
CIOA3.7	-0.03538	0.06241	-0.56679	0.64865
CIOA3.8	0.61388	0.16806	3.65277	0.34410
CIOA3.10	0.00771	0.02860	0.26964	4.83774

19 CIWH3 = CIWH3.0+CIWH3.1*JS1+CIWH3.2*JS2+CIWH3.3*JS3+CIWH3.4*EXPWH3+CIWH3.5*(EP1WH3-EXPWH3)+CIWH3.6*DDS3+CIWH3.7*CIWH3(-1)+CIWH3.8*XTWRA1+CIWH3.9*(FIWH3(-1)+GWH3)

```
NOB = 37       NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.92693     CRSQ =   0.90258     F(9/27) =      38.057
SER =    0.7856      SSR =    16.664      DW(0) =   1.83
LHS MEAN =      7.78800     SR =      0.00005
```

COEF	VALUE	ST ER	T-STAT	MEAN
CIWH3.0	-2.77452	2.53213	-1.09573	1.00000
CIWH3.1	0.14946	0.45269	0.33016	0.24324
CIWH3.2	0.19577	0.53571	0.36545	0.24324
CIWH3.3	0.08070	0.47927	0.16838	0.24324
CIWH3.4	0.00943	0.01150	0.82007	108.65600
CIWH3.5	-0.00230	0.00848	-0.27168	-14.66380
CIWH3.6	4.35844E-06	3.39702E-06	1.28302	16366.10000
CIWH3.7	0.88736	0.09451	9.38897	7.87438
CIWH3.8	0.61573	1.20941	0.50912	0.64865
CIWH3.9	0.10371	0.05473	1.89493	18.73090

20 IFG4 = IFG4.0+IFG4.1*JS1+IFG4.2*JS2+IFG4.3*JS3+IFG4.4*PCO4+IFG4.5*LRCO4+IFG4.6*QFG4+IFG4.7*EP1CO4+IFG4.8*USINT+IFG4.9*IFG4(-1)

```
NOB = 44        NOVAR = 10
RANGE =  1966 1 TO 1976 4
RSQ =    0.99733        CRSQ =    0.99663        F(9/34) =  1412.480
SER =    2.3248         SSR =   183.757          DW(0) =    1.91
LHS MEAN =     87.38900     SR =        0.00056
```

COEF	VALUE	ST ER	T-STAT	MEAN
IFG4.0	18.24590	8.59980	2.12166	1.00000
IFG4.1	-5.64353	7.11485	-0.79320	0.25000
IFG4.2	-15.96500	6.41757	-2.48770	0.25000
IFG4.3	-19.99230	5.44394	-3.67240	0.25000
IFG4.4	-0.30594	0.18263	-1.67518	71.88570
IFG4.5	0.21434	0.17610	1.21714	43.06340
IFG4.6	0.65400	0.04392	14.89180	42.27180
IFG4.7	0.11952	0.18009	0.66369	71.54570
IFG4.8	0.59675	0.36585	1.63112	5.64159
IFG4.9	0.60397	0.04818	12.53550	87.32430

21 IWH4 = IWH4.0+IWH4.1*JS1+IWH4.2*JS2+IWH4.3*JS3+IWH4.4*EXPWH4+IWH4.5*LNWH4+IWH4.6*GWH4+IWH4.7*USINT+IWH4.8*(EP1WH4-EXPWH4)+IWH4.9*IWH4(-1)

```
NOB = 37        NOVAR = 10
RANGE =  1967 4 TO 1976 4
RSQ =    0.99135        CRSQ =    0.98847        F(9/27) =   343.993
SER =    1.4676         SSR =    58.151          DW(0) =    0.82
LHS MEAN =     32.14690     SR =        0.00065
```

COEF	VALUE	ST ER	T-STAT	MEAN
IWH4.0	-1.67777	4.12070	-0.40716	1.00000
IWH4.1	-1.29393	1.07711	-1.20129	0.24324
IWH4.2	-3.29093	1.73805	-1.89346	0.24324
IWH4.3	-3.74968	3.99807	-0.93787	0.24324
IWH4.4	-0.04310	0.00801	-5.38263	100.07900
IWH4.5	0.09993	0.04086	2.44563	48.85090
IWH4.6	0.86395	0.09740	8.86972	11.27780
IWH4.7	0.23334	0.22698	1.02803	5.84243
IWH4.8	0.07217	0.05807	1.24273	-6.98559
IWH4.9	0.77176	0.07449	10.36090	31.98080

9 DDFG4 = DDFG4.0+DDFG4.1*JS1+DDFG4.2*JS2+DDFG4.3*JS3+DDFG4.4*DY4+DDFG4.5*PCU4

```
NOB = 44       NOVAR = 6
RANGE =  1966 1 TO 1976 4
RSQ =    0.83542        CRSQ =    0.81377     F(5/38) =      38.579
SER =    0.1389         SSR =     0.733       DW(0) =   2.32
LHS MEAN =        3.40899     SR =         0.00014
```

COEF	VALUE	ST ER	T-STAT	MEAN
DDFG4.0	2.28182	0.09469	24.09810	1.00000
DDFG4.1	0.05413	0.05965	0.90739	0.25000
DDFG4.2	0.09442	0.05942	1.58883	0.25000
DDFG4.3	0.26432	0.05985	4.41651	0.25000
DDFG4.4	5.74252E-06	7.36852E-07	7.79331	1.96819E+05
DDFG4.5	-0.00148	0.00133	-1.10804	71.88570

10 DDWH4 = DDWH4.0+DDWH4.1*JS1+DDWH4.2*JS2+DDWH4.3*JS3+DDWH4.4*DY4+DDWH4.5*EXPWH4

```
NOB = 37       NOVAR = 6
RANGE =  1967 4 TO 1976 4
RSQ =    0.73617        CRSQ =    0.69362     F(5/31) =      17.300
SER =    0.0969         SSR =     0.291       DW(0) =   1.78
LHS MEAN =        3.60431     SR =         0.00003
```

COEF	VALUE	ST ER	T-STAT	MEAN
DDWH4.0	3.35471	0.08002	41.92160	1.00000
DDWH4.1	-0.15182	0.04460	-3.40371	0.24324
DDWH4.2	-0.32763	0.04482	-7.30936	0.24324
DDWH4.3	-0.07634	0.04454	-1.71414	0.24324
DDWH4.4	2.13918E-06	5.21020E-07	4.10576	2.09311E+05
DDWH4.5	-6.29070E-04	5.39452E-04	-1.16613	100.07900

14 FIBA3 = FIBA3.0+FIBA3.1*JS1+FIBA3.2*JS2+FIBA3.3*JS3+FIBA3.4*OPBA3+FIBA3.5*FPLS3+FIBA3.6*FIBA3(-1)+FIBA3.7*QBA3+FIBA3.8*(EP1CO3-PCO2)+FIBA3.9*DCWB

```
NOB = 37        NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.98437      CRSQ =    0.97916      F(9/27) =    188.939
SER =    0.4229       SSR =     4.829        DW(0) =   1.60
LHS MEAN =      6.47471       SR =        0.00017
```

COEF	VALUE	ST ER	T-STAT	MEAN
FIBA3.0	1.66705	0.88857	1.87609	1.00000
FIBA3.1	-0.29461	0.26671	-1.10460	0.24324
FIBA3.2	-1.58643	0.40396	-3.92724	0.24324
FIBA3.3	-0.05007	0.98710	-0.05072	0.24324
FIBA3.4	0.00159	0.00950	0.16780	98.41620
FIBA3.5	-0.80534	0.73197	-1.10024	1.10941
FIBA3.6	0.64256	0.06649	9.66379	6.45653
FIBA3.7	0.78376	0.08478	9.24450	2.32948
FIBA3.8	-0.01136	0.02674	-0.42498	-11.15960
FIBA3.9	-0.06233	0.63369	-0.09836	0.37838

15 FIOA3 = FIOA3.0+FIOA3.1*JS1+FIOA3.2*JS2+FIOA3.3*JS3+FIOA3.4*OPOA3+FIOA3.5*FIOA3(-1)+FIOA3.6*QOA3+FIOA3.7*DCWB+FIOA3.8*(EP1CO3-PCO2)+FIOA3.9*FPLS3

```
NOB = 37        NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.99645      CRSQ =    0.99526      F(9/27) =    841.730
SER =    0.1117       SSR =     0.337        DW(0) =   1.17
LHS MEAN =      3.59450       SR =        0.00005
```

COEF	VALUE	ST ER	T-STAT	MEAN
FIOA3.0	-0.91043	0.64670	-1.40780	1.00000
FIOA3.1	-0.19508	0.11134	-1.75201	0.24324
FIOA3.2	-0.32798	0.22385	-1.46518	0.24324
FIOA3.3	-0.72128	0.45999	-1.56806	0.24324
FIOA3.4	0.00408	0.00435	0.93611	53.96240
FIOA3.5	0.87633	0.08070	10.85880	3.63394
FIOA3.6	1.13640	0.08196	13.86590	1.20380
FIOA3.7	-0.18487	0.18807	-0.98297	0.37838
FIOA3.8	0.00651	0.00769	0.84691	-11.15960
FIOA3.9	0.16020	0.20418	0.78459	1.10941

16 FIWH3 = FIWH3.0+FIWH3.1*JS1+FIWH3.2*JS2+FIWH3.3*JS3+FIWH3.4*OPWH3+FIWH3.5*(EPIWH3-OPWH3)+FIWH3.6*FPLS3+FIWH3.7*FIWH3(-1)+FIWH3.8*QWH3+FIWH3.9*DCWB

```
NOB = 37        NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ =    0.98009      CRSQ =    0.97345      F(9/27) =    147.667
SER =    0.9866       SSR =     26.279       DW(0) =   1.95
LHS MEAN =      14.80600      SR =        0.00021
```

COEF	VALUE	ST ER	T-STAT	MEAN
FIWH3.0	-2.64296	3.33122	-0.79339	1.00000
FIWH3.1	1.26973	0.54642	2.32373	0.24324
FIWH3.2	-0.62053	0.69856	-0.88831	0.24324
FIWH3.3	-1.26223	1.54966	-0.81452	0.24324
FIWH3.4	0.01290	0.02845	0.45365	70.35480
FIWH3.5	-0.00218	0.01171	-0.18609	23.63780
FIWH3.6	-2.03700	1.67155	-1.21863	1.10941
FIWH3.7	1.01171	0.08737	11.57950	14.85850
FIWH3.8	1.03669	0.10036	10.32970	3.87242
FIWH3.9	-0.12011	1.94153	-0.06186	0.37838

22 IM7FG3 = IM7FG3.0+IM7FG3.1*JS1+IM7FG3.2*JS2+IM7FG3.3*JS3+IM7FG3.4*IMPCO4+IM7FG3.5*IMPBA3+IM7FG3.6*TIME+IM7FG3.7*(EP1CO4-PCO4)+IM7FG3.8*IMPSM4+IM7FG3.9*OFG8+IM7FG3.A*IFG8+IM7FG3.B*IM7FG3(-1)

NOB = 37 NOVAR = 12
RANGE = 1967 4 TO 1976 4
RSQ = 0.74613 CRSQ = 0.63442 F(11/25) = 6.679
SER = 0.2594 SSR = 1.682 DW(0) = 2.09
LHS MEAN = 0.68329 SR = 0.

COEF	VALUE	ST ER	T-STAT	MEAN
IM7FG3.0	-0.38912	1.80082	-0.21608	1.00000
IM7FG3.1	-0.45402	0.13803	-3.28920	0.24324
IM7FG3.2	0.05075	0.18970	0.26752	0.24324
IM7FG3.3	-0.05453	0.18231	-0.29908	0.24324
IM7FG3.4	0.00220	0.00608	0.36244	67.36960
IM7FG3.5	-0.01093	0.00514	-2.12760	70.25450
IM7FG3.6	0.02804	0.01568	1.78820	58.00000
IM7FG3.7	0.02201	0.02070	1.06339	-0.31561
IM7FG3.8	-0.00151	0.00127	-1.19081	117.16200
IM7FG3.9	1.16775E-06	2.93169E-06	0.39832	5.45389E+05
IM7FG3.A	-6.95464E-06	1.01120E-05	-0.68776	65797.20000
IM7FG3.B	0.27829	0.18416	1.51110	0.65087

23 IM7WH3 = IM7WH3.0+IM7WH3.1*JS1+IM7WH3.2*JS2+IM7WH3.3*JS3+IM7WH3.4*OWH8(-1)+IM7WH3.5*IMPWH4+IM7WH3.6*IMPWH3+IM7WH3.8*(EP1WH3-EXPWH3)+IM7WH3.9*TIME+IM7WH3.A*IM7WH3(-1)+IM7WH3.B*IM7WH4

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.60809 CRSQ = 0.45736 F(10/26) = 4.034
SER = 0.5047 SSR = 6.622 DW(0) = 1.79
LHS MEAN = 2.59851 SR = 0.00013

COEF	VALUE	ST ER	T-STAT	MEAN
IM7WH3.0	3.86847	1.44629	2.67476	1.00000
IM7WH3.1	-0.74249	1.15567	-0.64248	0.24324
IM7WH3.2	0.04152	0.87473	0.04747	0.24324
IM7WH3.3	0.37391	0.29948	1.24853	0.24324
IM7WH3.4	0.00283	0.01107	0.25528	87.76870
IM7WH3.5	0.02709	0.02252	1.20321	88.94640
IM7WH3.6	-0.02374	0.02388	-0.99409	95.56180
IM7WH3.8	-0.02280	0.02066	-1.10315	-14.66380
IM7WH3.9	-0.02373	0.01637	-1.44906	58.00000
IM7WH3.A	0.05968	0.20590	0.28985	2.63170
IM7WH3.B	-0.12358	0.08706	-1.41950	5.62334

24 EX8FG4 = IM7FG4.0+IM7FG4.1*JS1+IM7FG4.2*JS2+IM7FG4.3*JS3+IM7FG4.4*PCO4+IM7FG4.6*EXPWH4+IM7FG4.9*PSM4+IM7FG4.A*IFG8+IM7FG4.7*ERA+IM7FG4.8*EP1CO4+IM7FG4.B*DY9A

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.86283 CRSQ = 0.81007 F(10/26) = 16.354
SER = 1.4441 SSR = 54.218 DW(0) = 1.65
LHS MEAN = 7.58560 SR = -0.00023

COEF	VALUE	ST ER	T-STAT	MEAN
IM7FG4.0	-0.48489	10.63440	-0.04560	1.00000
IM7FG4.1	-0.49713	0.76098	-0.65327	0.24324
IM7FG4.2	-0.06552	1.02288	-0.06405	0.24324
IM7FG4.3	0.64356	1.04719	0.61456	0.24324
IM7FG4.4	-0.25041	0.12518	-2.00037	75.36910
IM7FG4.6	0.03269	0.02028	1.61188	100.07900
IM7FG4.9	0.01349	0.00649	2.07836	130.79000
IM7FG4.A	4.14636E-05	5.29906E-05	0.78247	65797.20000
IM7FG4.7	-4.64808	10.52210	-0.44175	1.09233
IM7FG4.8	0.18263	0.12770	1.43014	75.05350
IM7FG4.B	0.03129	0.00849	3.68535	336.51600

25 IM7WH4 = IM7WH4.0+IM7WH4.1*JS1+IM7WH4.2*JS2+IM7WH4.3*JS3+IM7WH4.4*IMPWH4+IM7WH4.5*IMPSM4+IM7WH4.6*(EP1WH4-EXPWH4)+IM7WH4.8*IM7WH4(-1)+IM7WH4.9*IMP+IM7WH4.A*IM7WH3+IM7WH4.B*QWH8(-3)

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.77632 CRSQ = 0.69306 F(10/26) = 9.129
SER = 0.9800 SSR = 24.970 DW(0) = 1.89
LHS MEAN = 5.62334 SR = 0.00014

COEF	VALUE	ST ER	T-STAT	MEAN
IM7WH4.0	6.18361	1.89551	3.26224	1.00000
IM7WH4.1	1.91798	1.36325	1.40692	0.24324
IM7WH4.2	4.11551	1.77471	2.31898	0.24324
IM7WH4.3	-1.26298	0.82177	-1.53689	0.24324
IM7WH4.4	0.02187	0.00875	2.49877	88.94640
IM7WH4.5	0.00704	0.00447	1.57331	117.16200
IM7WH4.6	-0.01208	0.04416	-0.27365	-6.98559
IM7WH4.8	0.11229	0.16298	0.68902	5.62860
IM7WH4.9	0.03167	0.03291	0.96222	58.00000
IM7WH4.A	-0.72556	0.34934	-2.07695	2.59851
IM7WH4.B	-0.06174	0.02348	-2.62932	3.55380

26 IM5FG3 = IM5FG3.0+IM5FG3.1*JS1+IM5FG3.2*JS2+IM5FG3.3*JS3+IM5FG3.4*QFG5+IM5FG3.5*IMPBA3+IM5FG3.6*IAG5+IM5FG3.7*IMPCO4+IM5FG3.8*DXUSSR+IM5FG3.9*ILSS+IM5FG3.A*IM5FG3(-1)

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.427 CRSQ = 0.20662 F(10/26) = 1.938
SER = 0.1209 SSR = 0.380 DW(0) = 2.23
LHS MEAN = 0.07313 SR = 0.00003

COEF	VALUE	ST ER	T-STAT	MEAN
IM5FG3.0	1.19218	1.69231	0.70447	1.00000
IM5FG3.1	-0.03201	0.05621	-0.56957	0.24324
IM5FG3.2	0.00818	0.05681	0.14398	0.24324
IM5FG3.3	0.01741	0.05986	0.29093	0.24324
IM5FG3.4	-0.01378	0.00691	-1.99545	22.30340
IM5FG3.5	3.18130E-05	0.00195	0.01635	70.25450
IM5FG3.6	-0.00543	0.00537	-1.00997	24.90070
IM5FG3.7	9.90846E-04	0.00297	0.33318	67.36960
IM5FG3.8	0.08185	0.09189	0.89073	0.48649
IM5FG3.9	-0.63382	1.29524	-0.48903	1.26050
IM5FG3.A	0.20615	0.21148	0.97480	0.07081

27 IM5WH3 = IM5WH3.0+IM5WH3.1*JS1+IM5WH3.2*JS2+IM5WH3.3*JS3+IM5WH3.4*IMPWH3+IM5WH3.5*IMPWH4+IM5WH3.6*DXUSSR+IM5WH3.7*QWH5+IM5WH3.8*IAG5+IM5WH3.9*TIME+IM5WH3.B*IM5WH3(-1)

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.57787 CRSQ = 0.41551 F(10/26) = 3.559
SER = 0.3450 SSR = 3.094 DW(0) = 2.21
LHS MEAN = 0.40330 SR = 0.00004

COEF	VALUE	ST ER	T-STAT	MEAN
IM5WH3.0	1.94063	1.41175	1.37462	1.00000
IM5WH3.1	-0.25292	0.16156	-1.56547	0.24324
IM5WH3.2	-0.00967	0.16556	-0.05842	0.24324
IM5WH3.3	-0.01671	0.16231	-0.10298	0.24324
IM5WH3.4	-0.01194	0.00412	-2.89529	95.56180
IM5WH3.5	0.00684	0.00461	1.48382	88.94640
IM5WH3.6	0.17999	0.30825	0.58392	0.48649
IM5WH3.7	-0.04766	0.02341	-2.03592	22.26480
IM5WH3.8	-0.01187	0.01177	-1.00828	24.90070
IM5WH3.9	0.00488	0.01776	0.27509	58.00000
IM5WH3.B	0.11900	0.17655	0.67402	0.40938

28 IM5WH4 = IM5WH4.0+IM5WH4.1*JS1+IM5WH4.2*JS2+IM5WH4.3*JS3+IM5WH4.4*IMPWH4+IM5WH4.5*IMPWH3+IM5WH4.6*QWH5+IM5WH4.7*DXUSSR+IM5WH4.8*IAGS+IM5WH4.9*TIME+IM5WH4.B*IM5WH4(-1)

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.8683 CRSQ = 0.81765 F(10/26) = 17.142
SER = 0.3563 SSR = 3.300 DW(0) = 2.01
LHS MEAN = 0.38522 SR = 0.00004

COEF	VALUE	ST ER	T-STAT	MEAN
IM5WH4.0	3.53406	1.48232	2.38414	1.00000
IM5WH4.1	0.11450	0.16659	0.68729	0.24324
IM5WH4.2	-0.02592	0.18259	-0.14198	0.24324
IM5WH4.3	-0.25831	0.16675	-1.54916	0.24324
IM5WH4.4	-0.01705	0.00571	-2.98766	88.94640
IM5WH4.5	0.00129	0.00552	0.23314	95.56180
IM5WH4.6	-0.01519	0.02557	-0.59429	22.26480
IM5WH4.7	1.56247	0.37306	4.18825	0.48649
IM5WH4.8	-0.01674	0.01235	-1.35615	24.90070
IM5WH4.9	-0.03374	0.01823	-1.85047	38.00000
IM5WH4.B	0.65196	0.14257	4.57942	0.36495

29 EXPBA3 = EXPBA3.0+EXPBA3.1*JS1+EXPBA3.2*JS2+EXPBA3.3*JS3+EXPBA3.4*PBA2+EXPBA3.5*CIBA3(-1)+EXPBA3.6*FIBA3(-1)+EXPBA3.7*DCWB+EXPBA3.8*QBA3+EXPBA3.9*EXPBA3(-1)

NOB = 37 NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.97031 CRSQ = 0.96041 F(9/27) = 98.034
SER = 7.8272 SSR = 1654.160 DW(0) = 2.54
LHS MEAN = 79.98700 SR = 0.00195

COEF	VALUE	ST ER	T-STAT	MEAN
EXPBA3.0	24.76210	13.89930	1.78154	1.00000
EXPBA3.1	-4.63606	4.73323	-0.97947	0.24324
EXPBA3.2	-9.24969	6.24513	-1.48110	0.24324
EXPBA3.3	-7.03819	16.88190	-0.41691	0.24324
EXPBA3.4	0.20949	0.16077	1.30309	83.86560
EXPBA3.5	5.23509	4.86665	1.07571	1.83379
EXPBA3.6	-1.61971	1.20780	-1.34105	6.45653
EXPBA3.7	25.78840	10.54810	2.44484	0.37838
EXPBA3.8	-1.07422	1.62699	-0.66025	2.32948
EXPBA3.9	0.46394	0.11241	4.12716	78.21490

30 EXPOA3 = EXPOA3.0+EXPOA3.1*JS1+EXPOA3.2*JS2+EXPOA3.3*JS3+EXPOA3.4*POA2+EXPOA3.5*CIOA3(-1)+EXPOA3.6*FIOA3(-1)+EXPOA3.7*QOA3+EXPOA3.8*EXPOA3(-1)+EXPOA3.9*DCWB

NOB = 37 NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.92757 CRSQ = 0.90343 F(9/27) = 38.422
SER = 8.1117 SSR = 1776.610 DW(0) = 2.07
LHS MEAN = 71.91890 SR = 0.00069

COEF	VALUE	ST ER	T-STAT	MEAN
EXPOA3.0	57.14280	29.69380	1.92440	1.00000
EXPOA3.1	-4.68634	5.79518	-0.80866	0.24324
EXPOA3.2	-21.52120	9.86679	-2.18118	0.24324
EXPOA3.3	-17.57150	30.15000	-0.58280	0.24324
EXPOA3.4	0.04783	0.15256	0.31349	83.77770
EXPOA3.5	18.12390	21.73110	0.83401	0.34410
EXPOA3.6	-6.20775	3.46236	-1.79292	3.63394
EXPOA3.7	-2.12973	5.88765	-0.36173	1.20380
EXPOA3.8	0.46385	0.11853	3.91321	70.29280

31 EXPWH3 = EXPWH3.0+EXPWH3.1*JS1+EXPWH3.2*JS2+EXPWH3.3*JS3+EXPWH3.4*EXPWH4+EXPWH3.5*ER34+EXPWH3.6*CIWH3(-1)+EXPWH3.7*DCWB+EXPWH3.8*FIWH3(-1)+EXPWH3.9*QWH3+EXPWH3.10*EXPWH3(-1)

NOB = 37 NOVAR = 11
RANGE = 1967 4 TO 1976 4
RSQ = 0.9891 CRSQ = 0.98491 F(10/26) = 235.953
SER = 6.6918 SSR = 1164.290 DW(0) = 1.62
LHS MEAN = 108.65600 SR = -0.00302

COEF	VALUE	ST ER	T-STAT	MEAN
EXPWH3.0	68.17460	62.53450	1.09019	1.00000
EXPWH3.1	5.58909	3.61685	1.54529	0.24324
EXPWH3.2	6.30516	4.56896	1.38000	0.24324
EXPWH3.3	-9.53310	10.63580	-0.89632	0.24324
EXPWH3.4	0.51784	0.07690	6.73381	100.07900
EXPWH3.5	-125.34900	65.96540	-1.90022	1.02155
EXPWH3.6	3.39158	1.40205	2.41901	7.87438
EXPWH3.7	-6.32730	9.49254	-0.66656	0.37838
EXPWH3.8	0.59318	0.50996	1.16320	14.85850
EXPWH3.9	0.81578	0.69973	1.16586	3.87242
EXPWH3.10	0.74738	0.05459	13.69190	106.83400

32 IMPBA3 = IMPBA3.0+IMPBA3.1*JS1+IMPBA3.2*JS2+IMPBA3.3*JS3+IMPBA3.4*EXPBA3+IMPBA3.5*ER3+IMPBA3.6*TIME

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99859 CRSQ = 0.99831 F(6/30) = 3543.040
SER = 1.2699 SSR = 48.380 DW(0) = 0.44
LHS MEAN = 70.25450 SR = 0.00214

COEF	VALUE	ST ER	T-STAT	MEAN
IMPBA3.0	65.47240	5.35667	12.22260	1.00000
IMPBA3.1	-0.18840	0.58916	-0.31977	0.24324
IMPBA3.2	0.11977	0.59014	0.20296	0.24324
IMPBA3.3	0.17101	0.58941	0.29014	0.24324
IMPBA3.4	0.86757	0.01217	71.26420	79.92700
IMPBA3.5	-59.10020	5.28410	-11.18450	1.11347
IMPBA3.6	0.02105	0.03375	0.62365	58.00000

33 IMPWH3 = IMPWH3.0+IMPWH3.1*JS1+IMPWH3.2*JS2+IMPWH3.3*JS3+IMPWH3.4*EXPWH3+IMPWH3.5*TIME+IMPWH3.6*ER3

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99867 CRSQ = 0.9984 F(6/30) = 3743.690
SER = 1.7152 SSR = 88.254 DW(0) = 0.44
LHS MEAN = 95.56180 SR = 0.00249

COEF	VALUE	ST ER	T-STAT	MEAN
IMPWH3.0	84.23920	6.56737	12.82690	1.00000
IMPWH3.1	-0.18565	0.79375	-0.23388	0.24324
IMPWH3.2	0.10131	0.79123	0.12805	0.24324
IMPWH3.3	0.10219	0.79012	0.12933	0.24324
IMPWH3.4	0.85678	0.01030	83.21310	108.65600
IMPWH3.5	0.05006	0.04320	1.15875	58.00000
IMPWH3.6	-76.05010	6.61907	-11.48950	1.11347

34 IMPCO4 = IMPCO4.A+IMPCO4.B*JS1+IMPCO4.C*JS2+IMPCO4.D*JS3+IMPCO4.E*PCO4+IMPCO4.F*ER4+IMPCO4.G*TIME

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99936 CRSQ = 0.99923 F(6/30) = 7802.530
SER = 0.6473 SSR = 12.570 DW(0) = 0.71
LHS MEAN = 67.36960 SR = 0.00211

COEF	VALUE	ST ER	T-STAT	MEAN
IMPCO4.A	60.31330	2.35973	25.55940	1.00000
IMPCO4.B	0.24084	0.30137	0.79915	0.24324
IMPCO4.C	0.39719	0.29992	1.32432	0.24324
IMPCO4.D	0.21843	0.30022	0.72757	0.24324
IMPCO4.E	0.84802	0.00804	105.45100	75.36910
IMPCO4.F	-58.52500	2.90936	-20.11610	1.09233
IMPCO4.G	0.11832	0.02134	5.54336	58.00000

35 IMPWH4 = IMPWH4.A+IMPWH4.B*JS1+IMPWH4.C*JS2+IMPWH4.D*JS3+IMPWH4.E*EXPWH4+IMPWH4.F*ER4+IMPWH4.G*TIME

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99935 CRSQ = 0.99922 F(6/30) = 7702.890
SER = 1.0280 SSR = 31.704 DW(0) = 0.47
LHS MEAN = 88.94640 SR = 0.00113

COEF	VALUE	ST ER	T-STAT	MEAN
IMPWH4.A	69.27370	4.44788	15.57460	1.00000
IMPWH4.B	-0.21719	0.48145	-0.45154	0.24324
IMPWH4.C	-0.15263	0.49963	-0.30550	0.24324
IMPWH4.D	-0.18761	0.47414	-0.39568	0.24324
IMPWH4.E	0.84269	0.00851	99.00870	100.07900
IMPWH4.F	-64.13670	5.61104	-11.43050	1.09233
IMPWH4.G	0.09536	0.03201	2.97932	58.00000

36 PCO2 = PCO2.0+PCO2.1*JS1+PCO2.2*JS2+PCO2.3*JS3+PCO2.4*PCO4+PCO2.5*T12+PCO2.6*ER34+PCO2.7*TIME

NOB = 37 NOVAR = 8
RANGE = 1967 4 TO 1976 4
RSQ = 0.99627 CRSQ = 0.99537 F(7/29) = 1107.600
SER = 2.2700 SSR = 149.438 DW(0) = 1.74
LHS MEAN = 87.10100 SR = 0.00134

COEF	VALUE	ST ER	T-STAT	MEAN
PCO2.0	-97.32550	28.27990	-3.44151	1.00000
PCO2.1	0.50737	1.59423	0.31819	0.24324
PCO2.2	-2.67021	1.04758	-2.54892	0.24324
PCO2.3	0.12577	1.05184	0.11958	0.24324
PCO2.4	1.05632	0.02326	45.40460	75.36910
PCO2.5	-0.71067	0.37551	-1.89251	9.57351
PCO2.6	89.26980	22.36570	3.99138	1.02155
PCO2.7	0.36067	0.16117	2.23782	58.00000

37
```
PWH2 = PWH2.0+PWH2.1*JS1+PWH2.2*JS2+PWH2.3*JS3+PWH2.4*EXPWH4+PWH2.5*ER34+PWH2.6*CIWH3(-1)+PWH2.8*FIWH3(-1)+PWH2.7*
DCWB+PWH2.9*PWH2(-1)
```

NOB = 37   NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.97994   CRSQ = 0.97326   F(9/27) = 146.576
SER = 6.4219   SSR = 1113.500   DW(0) = 1.72
LHS MEAN = 94.94330   SR = 0.00333

COEF	VALUE	ST ER	T-STAT	MEAN
PWH2.0	-19.93400	65.34870	-0.30504	1.00000
PWH2.1	3.22131	3.41562	0.94311	0.24324
PWH2.2	3.27789	4.20664	0.77922	0.24324
PWH2.3	6.77230	5.41178	1.25140	0.24324
PWH2.4	0.32879	0.06663	4.93443	100.07900
PWH2.5	34.95370	65.83790	0.53091	1.02155
PWH2.6	-1.71826	1.33388	-1.28817	7.87438
PWH2.8	0.51615	0.42074	1.22676	14.85850
PWH2.7	5.70961	10.16870	0.56149	0.37838
PWH2.9	0.50189	0.11868	4.22900	93.12460

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```
PBA2 = PBA2.0+PBA2.1*JS1+PBA2.2*JS2+PBA2.3*JS3+PBA2.4*PCO2+PBA2.5*T12+PBA2.6*FIBA3(-1)+PBA2.8*CIBA3(-1)+PBA2.7*
DCWB+PBA2.9*PBA2(-1)
```

NOB = 37   NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.9902   CRSQ = 0.98694   F(9/27) = 303.214
SER = 3.9380   SSR = 418.720   DW(0) = 1.52
LHS MEAN = 83.86560   SR = 0.00284

COEF	VALUE	ST ER	T-STAT	MEAN
PBA2.0	-8.10162	6.81607	-1.18861	1.00000
PBA2.1	5.24753	2.67602	1.96094	0.24324
PBA2.2	1.07539	3.02216	0.35583	0.24324
PBA2.3	2.27966	4.26160	0.53493	0.24324
PBA2.4	0.73716	0.08215	8.97357	87.10100
PBA2.5	-0.53835	0.43676	-1.23260	9.57351
PBA2.6	0.63628	0.53990	1.17852	6.45653
PBA2.8	4.80820	2.44180	1.96912	1.83379
PBA2.7	7.16456	5.41262	1.32368	0.37838
PBA2.9	0.18433	0.09223	1.99858	82.37980

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```
POA2 = POA2.0+POA2.1*JS1+POA2.2*JS2+POA2.3*JS3+POA2.4*PCO2+POA2.5*T12+POA2.6*FIOA3(-1)+POA2.8*CIOA3(-1)+POA2.7*
POA2(-1)+POA2.9*DCWB
```

NOB = 37   NOVAR = 10
RANGE = 1967 4 TO 1976 4
RSQ = 0.98164   CRSQ = 0.97552   F(9/27) = 160.384
SER = 5.3081   SSR = 760.763   DW(0) = 1.49
LHS MEAN = 83.77770   SR = 0.00238

COEF	VALUE	ST ER	T-STAT	MEAN
POA2.0	33.81520	16.84780	2.00710	1.00000
POA2.1	-0.04498	4.43615	-0.01014	0.24324
POA2.2	-8.14569	6.20146	-1.31351	0.24324
POA2.3	-14.99340	9.04707	-1.65748	0.24324
POA2.4	0.51961	0.12372	4.19987	87.10100
POA2.5	-0.01256	0.70585	-0.01779	9.57351
POA2.6	-2.15150	2.15967	-0.99622	3.63394
POA2.8	-38.41380	14.77230	-2.60040	0.34410
POA2.7	0.37103	0.13590	2.73013	82.43110
POA2.9	2.42076	6.62253	0.36553	0.37838

40 FPCO2 = FPCO2.0+FPCO2.1*JS1+FPCO2.2*JS2+FPCO2.3*JS3+FPCO2.4*DCO3+FPCO2.5*PCO2+FPCO2.6*T12+FPCO2.7*FPCO2(-1)

```
NOB = 37        NOVAR = 8
RANGE =  1967 4 TO 1976 4
RSQ =    0.98933      CRSQ =    0.98675     F(7/29) =   384.019
SER =    3.2818       SSR =   312.329       DW(0) =   1.12
LHS MEAN =    74.21750    SR =          0.00313
```

COEF	VALUE	ST ER	T-STAT	MEAN
FPCO2.0	1.60258	2.17448	0.73700	1.00000
FPCO2.1	8.22003	2.02215	4.06500	0.24324
FPCO2.2	4.13229	1.58244	2.61134	0.24324
FPCO2.3	6.74314	6.27914	1.07390	0.24324
FPCO2.4	-0.77017	2.31366	-0.33288	0.67263
FPCO2.5	0.82027	0.06195	13.24040	87.10100
FPCO2.6	-1.48330	0.34377	-4.31476	9.57351
FPCO2.7	0.15279	0.07564	2.01995	73.57910

41 OPBA3 = OPBA3.P+OPBA3.Q*JS1+OPBA3.R*JS2+OPBA3.S*JS3+OPBA3.T*PBA2+OPBA3.U*FIBA3(-1)+OPBA3.V*DCWB+OPBA3.W*OPBA3(-1)+
OPBA3.X*EXPBA3

```
NOB = 37        NOVAR = 9
RANGE =  1967 4 TO 1976 4
RSQ =    0.98537      CRSQ =    0.9812      F(8/28) =   235.810
SER =    4.4046       SSR =   543.222       DW(0) =   0.43
LHS MEAN =    58.41620    SR =          0.00226
```

COEF	VALUE	ST ER	T-STAT	MEAN
OPBA3.P	4.69181	8.01442	0.58542	1.00000
OPBA3.Q	-3.52657	2.80527	-1.25712	0.24324
OPBA3.R	-4.67256	3.64296	-1.28263	0.24324
OPBA3.S	-9.12907	5.43712	-1.67902	0.24324
OPBA3.T	0.51915	0.08593	6.04148	83.86560
OPBA3.U	-1.52072	0.69064	-2.20191	6.45653
OPBA3.V	4.03806	6.07994	0.66416	0.37838
OPBA3.W	0.30997	0.20151	1.53827	57.48340
OPBA3.X	0.06096	0.16430	0.37106	79.92700

42 OPOA3 = OPOA3.P+OPOA3.Q*JS1+OPOA3.R*JS2+OPOA3.S*JS3+OPOA3.T*EXPOA3+OPOA3.U*FIOA3(-1)+OPOA3.V*DCWB+OPOA3.W*OPOA3(-1)+OPOA3.L*POA2

```
NOB = 37        NOVAR = 9
RANGE =  1967 4 TO 1976 4
RSQ =    0.99036      CRSQ =    0.9876      F(8/28) =   359.500
SER =    2.9704       SSR =   247.052       DW(0) =   1.24
LHS MEAN =    53.96240    SR =          0.00117
```

COEF	VALUE	ST ER	T-STAT	MEAN
OPOA3.P	65.51370	11.72210	5.58892	1.00000
OPOA3.Q	-10.20420	2.40793	-4.23777	0.24324
OPOA3.R	-23.18850	4.17367	-5.55590	0.24324
OPOA3.S	-38.17370	6.26238	-6.09572	0.24324
OPOA3.T	-0.11734	0.05670	-2.06975	71.91890
OPOA3.U	-9.69378	1.52309	-6.36456	3.63394
OPOA3.V	11.33390	4.33488	2.61459	0.37838
OPOA3.W	0.20544	0.08721	2.35570	53.23280
OPOA3.L	0.40939	0.05248	7.80137	83.77770

```
43 OPWH3 = OPWH3.0+OPWH3.1*JS1+OPWH3.2*JS2+OPWH3.3*JS3+OPWH3.4*EXPWH3+OPWH3.5*DCWR+OPWH3.6*FIWH3(-1)+OPWH3.7*OPWH3(-1)
+OPWH3.8*PWH2

NOB = 37      NOVAR = 9
RANGE =  1967 4 TO 1976 4
RSQ =    0.99037     CRSQ =    0.98762     F(8/28) =    359.971
SER =    4.3210      SSR =   522.794       DW(0) =   0.68
LHS MEAN =     70.35480    SR =         0.00275

COEF          VALUE          ST ER          T-STAT          MEAN

OPWH3.0       29.23620       10.77470        2.71340         1.00000
OPWH3.1       -1.84952        2.50096       -0.73952         0.24324
OPWH3.2       -4.25376        2.81693       -1.51007         0.24324
OPWH3.3      -10.88550        3.89029       -2.79812         0.24324
OPWH3.4       -0.03786        0.07168       -0.52819       108.65600
OPWH3.5       15.20980        7.66610        1.98404         0.37838
OPWH3.6       -1.19347        0.28993       -4.11637        14.85850
OPWH3.7        0.41506        0.13037        3.18378        69.23260
OPWH3.8        0.34344        0.07773        4.41807        94.94330
```

```
44 XIPBA1 = XIPBA1.0+XIPBA1.1*XIPBA1(-1)+XIPBA1.2*(EXPBA3(-3)-XIPBA1(-1))+XIPBA1.3*XIPBA1(-4)

NOB = 37      NOVAR = 4
RANGE =  1967 4 TO 1976 4
RSQ =    0.88959     CRSQ =    0.87955     F(3/33) =    88.626
SER =    7.5441      SSR =  1878.140       DW(0) =   2.06
LHS MEAN =     60.88520    SR =         0.00223

COEF          VALUE          ST ER          T-STAT          MEAN

XIPBA1.0       4.68090        5.46537        0.85647         1.00000
XIPBA1.1       0.99146        0.11593        8.55223        59.92520
XIPBA1.2       0.01494        0.13146        0.11368        15.18520
XIPBA1.3      -0.06096        0.15961       -0.38196        56.36260
```

```
45 XIPOA1 = XIPOA1.0*XIPOA1(-1)+XIPOA1.1*(EXPOA3(-3)-XIPOA1(-1))+XIPOA1.2*XIPOA1(-4)

NOB = 37      NOVAR = 3
RANGE =  1967 4 TO 1976 4
RSQ =    0.9607      CRSQ =    0.95839     F(2/34) =    415.549
SER =    3.4232      SSR =   398.413       DW(0) =   1.84
LHS MEAN =     53.41600    SR =         3.52092

COEF          VALUE          ST ER          T-STAT          MEAN

XIPOA1.0       1.01732        0.09973       10.20050        52.42300
XIPOA1.1      -0.08431        0.05957       -1.41539        15.01490
XIPOA1.2       0.02549        0.11755        0.21685        49.26810
```

46 XIPWH1 = XIPWH1.0+XIPWH1.1*XIPWH1(-1)+XIPWH1.2*(EXPWH3(-3)-XIPWH1(-1))+XIPWH1.3*XIPWH1(-4)

NOB = 37 NOVAR = 4
RANGE = 1967 4 TO 1976 4
RSQ = 0.83058 CRSQ = 0.81518 F(3/33) = 53.928
SER = 13.4027 SSR = 5927.880 DW(0) = 1.84
LHS MEAN = 79.97610 SR = 0.00325

COEF	VALUE	ST ER	T-STAT	MEAN
XIPWH1.0	10.05570	7.23024	1.39078	1.00000
XIPWH1.1	0.71150	0.15065	4.72275	78.61890
XIPWH1.2	0.16307	0.10947	1.48964	23.58790
XIPWH1.3	0.13998	0.19824	0.70613	72.41250

47 XPBA1 = JS1*(XPBA1.0+XPBA1.1*EXPBA3(-3)+XPBA1.2*EXPBA3(-4)+XPBA1.3*EXPBA3(-5)+XPBA1.4*EXPBA3(-6)+XPBA1.5*EXBA3(-6)
+XPBA1.6*TIME)

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99994 CRSQ = 0.99992 F(6/30) = 7.87E+04
SER = 0.3260 SSR = 3.189 DW(0) = 2.00
LHS MEAN = 17.62470 SR = 0.00067

COEF	VALUE	ST ER	T-STAT	MEAN
XPBA1.0	-9.13052	1.07159	-8.52050	0.24324
XPBA1.1	0.10904	0.06169	1.76759	17.70830
XPBA1.2	2.15746	0.10418	20.70860	17.49220
XPBA1.3	-1.38613	0.08354	-16.59330	17.19680
XPBA1.4	-0.12140	0.02978	-4.07652	15.64670
XPBA1.5	-11.66150	0.63872	-18.25780	0.15416
XPBA1.6	0.55610	0.02408	23.08930	13.86490

48 XPOA1 = JS1*(XPOA1.0+XPOA1.1*EXPOA3(-3)+XPOA1.2*EXPOA3(-4)+XPOA1.3*EXPOA3(-5)+XPOA1.4*EXPOA3(-6)+XPOA1.5*EXOA3(-6)
+XPOA1.6*TIME)

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99575 CRSQ = 0.9949 F(6/30) = 1172.410
SER = 2.2699 SSR = 154.576 DW(0) = 2.00
LHS MEAN = 15.87750 SR = -0.00124

COEF	VALUE	ST ER	T-STAT	MEAN
XPOA1.0	-139.70000	10.99070	-12.71080	0.24324
XPOA1.1	1.72520	0.21155	8.15513	15.14280
XPOA1.2	2.17593	0.27381	7.94691	16.61380
XPOA1.3	-3.26395	0.50352	-6.48221	14.88210
XPOA1.4	0.72562	0.21121	3.43558	14.78130
XPOA1.5	190.27800	61.80600	3.07862	0.00741
XPOA1.6	1.70124	0.16671	10.20450	13.86490

49 XPWH1 = JS1*(XPWH1.0+XPWH1.1*EXPWH3(-3)+XPWH1.2*EXPWH3(-4)+XPWH1.3*EXPWH3(-5)+XPWH1.4*EXPWH3(-6)+XPWH1.5*EXWH3(-6)
+XPWH1.6*TIME)

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.99974 CRSQ = 0.99969 F(6/30) = 1.96E+04
SER = 0.7672 SSR = 17.657 DW(0) = 2.00
LHS MEAN = 21.50420 SR = 0.00066

COEF	VALUE	ST ER	T-STAT	MEAN
XPWH1.0	-11.66650	3.59418	-3.24594	0.24324
XPWH1.1	2.46070	0.36181	6.80111	24.27730
XPWH1.2	-2.53119	0.62050	-4.07926	24.34530
XPWH1.3	1.25191	0.54303	2.30540	22.70090
XPWH1.4	-0.18468	0.24043	-0.76811	20.99390
XPWH1.5	-0.34787	0.32862	-1.05856	1.03057
XPWH1.6	0.14735	0.05150	2.85904	13.86490

52 EXPWH4 = IMPWH4.0+IMPWH4.1*TSTK+IMPWH4.2*TSTK*JS1+IMPWH4.3*TSTK*JS2+IMPWH4.4*TSTK*JS3+IMPWH4.5*(DISPWH+DISPWH(-1)+
DISPWH(-2))+IMPWH4.6*EXPWH4(-1)

NOB = 37 NOVAR = 7
RANGE = 1967 4 TO 1976 4
RSQ = 0.91997 CRSQ = 0.90397 F(6/30) = 57.478
SER = 15.2062 SSR = 6936.860 DW(0) = 2.15
LHS MEAN = 100.07900 SR = -0.00024

COEF	VALUE	ST ER	T-STAT	MEAN
IMPWH4.0	-54.70650	38.14110	-1.43432	1.00000
IMPWH4.1	0.11991	0.33635	0.35649	69.86380
IMPWH4.2	0.04325	0.13782	0.31379	14.63880
IMPWH4.3	-0.00485	0.23546	-0.02058	11.43880
IMPWH4.4	0.07494	0.10014	0.74835	23.09990
IMPWH4.5	2.56406	0.62957	4.07268	27.02520
IMPWH4.6	0.75647	0.08612	8.78387	98.88770